TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. XIII, No. 8. AUGUST, 1936. PRICE 6d.

CONTENTS.

	PAGE.
Biological Control in the West Indies	197
Insects Attacking Sugar-Cane on the Island of Tobago, B.W.I.	199
The Propagation of Cuttings in Tropical Climates	201
Plant Virus Problems	203
The British West Indies Central Sugar Cane Breeding Station, Barbados, B.W.I.	204
Miscellaneous Notes	212
The Birds of St. Kitts and Nevis	213
Cocoa : World Consumption	217
Cauliflower Cultivation in the Tropics	218
Reviews	220
Sugar Notes	222
Chemical Notes	223
Trend of the Markets	224

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 2183

TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C.3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from the various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

BIOLOGICAL CONTROL IN THE WEST INDIES.

TWO months ago, Dr. Myers, who has been engaged on biological control work in the West Indies and South America for the past seven and a half years, returned to England on the conclusion of his sugar-cane work in the Caribbean area. A large proportion of his work has been of an exploratory character, and his searches for new and effective parasites involved long and arduous journeys into the hinterland of British Guiana. That these journeys were long can readily be checked by a glance at the itinerary in his Second Report*, but—characteristically—the reader is not informed that the searches were prosecuted regardless of personal comfort or safety, and that Dr. Myers paid heavily in illness for the zeal with which he carried out his work.

It is interesting in this connection to view in very broad outline the position with regard to Biological Control in the West Indies. The concept itself of such control of pests in this part of the world is by no means new ; for instance, nearly a hundred years have passed since *Bufo marinus* was brought from Cayenne into the West Indies. The modern element in this idea lies in the scientific direction of control—the evaluation, as far as possible, from ecological considerations, of (1) the chance of survival of an animal introduced into a given region, and (2) the chances of its activities being rigorously confined to the host against which its introduction is contemplated. Early efforts in this direction were somewhat premature : *Bufo marinus* was introduced, apparently, to destroy cane-rats. In this its success is greatly to be doubted. For once, however, the " biologists " did not have to suffer the consequences of their miscalculation, as the toad has proved of value in eating great numbers of injurious insects, many of which would in other circumstances be saved from attack by their sheer bulk. Such a happy result of a casual introduction of this kind is not likely to be duplicated. In the case of the mongoose the other side of the picture is revealed : here the introduction of the animal was definitely considered satisfactory at first, and in Jamaica and one or two other islands its arrival has not since been regretted. Elsewhere, however, it is considered to do far more harm than good, and is probably indirectly beneficial to insect pests.

* Second Report on an Investigation into the Biological Control of West Indian Insect Pests, 1935.

The introduction of birds into various Islands has been little practised. The Grackle (*Holoquiscalus*) was introduced into Antigua and St. Kitts with little noticeable result. The Tyrannidae were at one time suspected of being harmful, but investigation of their food proved the belief to be without foundation, and the family is now considered generally to be sufficiently beneficial to warrant encouragement of indigenous species, though not importation of others. This, as a matter of fact, strikes the keynote of modern practice in biological control: the generalized feeder is now rarely considered as a prospective agent of control for a new terrain. It is realized that it is impossible to make anything more than an intelligent guess at the ultimate result of introducing into an established fauna a new element which has a directly depressing effect on an unknown number of its members. The direct effects might be fairly accurately guessed, but secondary effects could not be foretold, and the extent of the secondary effects would be directly proportional to the efficiency of the introduced general feeder.

In view of the Darwinian conception of a "chain of consequences", it is clear that the introduction of even a single parasitic species strictly confined to a single host, sets a difficult problem as regards forecasting the secondary effects of such action. Actually, in such a case, it usually happens that the secondary effects can be ignored, since it is assumed that the "predator complex", which is postulated as surrounding an abundant pest, can, on the reduction of the pest, fall into secondary equilibrium with what is left, and satisfactorily fend for itself. Consequently, when a specific parasite of a pest is known to exist, the question of utilizing it for control in a new habitat to all intents and purposes depends for its answer on whether the new habitat (other than the host itself) appears to be suitable. The evaluation of at least the broader features of environment is now relatively simple: meteorological data supply a good deal of the information required for a given area. Among the chief factors are the average temperature and humidity of the particular "climate", however restricted, in which the parasite will be compelled to live, and more important, the range of variation of both, and the time over which low or high values of either prevail. The entomologist is able to determine experimentally certain values for the limits of tolerance of his proposed introduction, and if these fall outside the range of variation determined for various factors of the new environment, then experimental introduction may be considered justified. The "experiment" lies in seeing how the insect overcomes the biological resistance of its new habitat. This cannot be evaluated experimentally beforehand, nor even assessed beyond an intelligent guess, and it is this quite incalculable factor which is responsible in these days for failure of parasites to establish themselves, or to be as effective as desired. In this respect, biological control must always be exposed to the disadvantages of procedure by trial and error, not the least of which is the general discredit which "failure" in several specific instances is liable to bring on the concept as a whole.

Recent introductions of specific parasites of certain pests into various islands of the West Indies have had a chequered history. A parasite (*Eretmocerus serius*) introduced from Malaya into Cuba, and later into Jamaica, Haiti and New Providence to deal with Black Fly of Citrus, *Aleurocanthus woglumi*, is reported as proving extremely effective.

The Amazon Fly, *Metagonistylum minense*, has been successfully established in the sugar-cane fields of British Guiana, and is also reported to be giving satisfactory control of the Small Moth Borer in St. Lucia. When introduced into Antigua, however, it did not establish control over its host.

Lixophaga diatraeae, an effective parasite of *Diatraea* in Cuba, was introduced into Antigua and Barbados, but after a promising start failed to fulfil early hopes, though in St. Kitts it has maintained a very satisfactory standard since its importation. Similarly, *Zenillia palpalis*, parasitic on the Large Moth Borer, *Castnia licus*, was introduced from British Guiana into Trinidad in spite of considerable technical difficulties, but as yet cannot be regarded as established in its new environment.

Another fly, *Paratheresia claripalpis*, has quite recently been introduced into Martinique from Trinidad against *Diatraea*, but the outcome of the work is still unknown.

Another recent introduction is that of *Dasyscapus parvipennis* from the Gold Coast into Trinidad and Grenada to attack Cacao Thrips, and into Puerto Rico to control another host, Onion Thrips. Recoveries in the field have been made, but the work is in too early a stage for the final effect to be estimated.

An interesting enterprise undertaken in Barbados, differing basically from the other methods discussed, is the mass-breeding of *Trichogramma minutum*, an egg-parasite of the Small Moth Borer of Sugar-cane. Mass-production of the Amazon Fly is being employed in Antigua as a palliative measure.

In certain cases it is clear, from experience already accumulated, that really efficient biological control is almost impossible to obtain. Indigenous insects which maintain their status as pests in spite of a large parasite complex, for instance, are rarely brought under control by fresh additions to the list of their enemies—if additions can be made at all. The Cacao Beetle, *Steirastoma depressum*, and the Mahogany Tip-borer, *Hypsipyla*, fall into this category. The froghopper of Trinidad, in one respect, is to be regarded as belonging to yet another class. In the cane fields, the total effect of its parasites is frequently too small to prevent severe "blighting". It was accordingly felt that a search conducted in the natural habitat of closely related species

might result in the discovery of a really effective parasite. This search was prosecuted by the entomologists engaged on the problem with a tenacity in face of disheartening natural difficulties which compels the greatest admiration, but unfortunately no new effective parasite was found. At present a solution of the problem is being sought in the direction of varietal resistance of sugar-cane to attack.

This last example raises a new question from the agriculturalist's standpoint : when an insect pest has no known efficient parasite, the experienced entomological research worker can usually suggest the regions elsewhere in which such a parasite, if existent, may be found. He is not able to forecast the degree of probability of finding it. Where a pest which does not yield to easily applied cultural or insecticidal measures is exacting a heavy toll on a relatively wealthy community, it is quite justifiable for the suggestion to be pressed that a search for a new parasite should be instituted. A successful outcome to the search must in such cases be regarded as a possibility, but a distinctly remote one, and expenditure on such a search can be considered by the planter only as a very speculative investment, and accordingly he must be prepared from the outset to expect no results. In the case of a wealthy planting community the relative loss of money in the case of failure would be small : in the case of a small community living on a narrow margin of profit, such loss would be a very serious matter, and on the principle that the poor man cannot afford to gamble, such a community should be prepared to examine carefully all the initially cheaper methods of partial control—and even parasites give only partial control—and prove them useless by actual trial, before staking a large sum on what can only fairly be regarded as a forlorn hope—the finding elsewhere of a parasite hitherto completely unknown.

There is undoubtedly a temptation for planters to regard biological control as the *only* solution to a pest problem which is complete and involves mainly non-recurrent expenditure, and therefore, in the long run, is cheap. When prevailing cultural and insecticidal methods and subsequent modifications of them have failed to achieve the required degree of control, the planting community feels that it can only look for a solution in the establishment of parasitic control. But this is not necessarily the next logical step. Recent as has been the development of programmes of plant-breeding for resistance to pests, successes in this direction even at this stage appear to be relatively numerous in proportion to the amount of effort and capital expended. This method of attack is clearly not of equal value in all cases. As an example, it would be extremely optimistic to expect a variety of lime resistant to the attacks of a comparatively "omnivorous" pest like *Diaprepes* to be produced, though even this is not impossible. On the other hand, breeding for resistance against sucking insects, and even boring insects, such as *Hypsipyla*, in several cases gives a prospect of at least as sure a solution as biological control, and one eventually no dearer to purchase.

R. G. F.

INSECTS ATTACKING SUGAR-CANE ON THE ISLAND OF TOBAGO, B.W.I.

By D. Vesey-FitzGerald.

History.

It seems probable that Tobago was discovered by Columbus simultaneously with Trinidad and Grenada in the year 1498. It was not however till 1720 that any serious attempt was made to settle there and then only on the condition that the Colonists did not plant cane, since it was feared that this would adversely affect the other established sugar islands. Fifty years later in 1770 this prohibition had ceased to be effective and the first sugar was exported from Tobago. It is extremely interesting to note however that in 1775 the cultivation of cane had to be abandoned in favour of cotton through the ravages of a certain species of "ant" which, appearing first in the windward parishes, rapidly spread over the country (Hay 1899). This damage could hardly have been due to a true ant, and it is interesting to speculate whether or not this is an early reference to the depredations of the froghopper.

The price of cotton having fallen, and cane-growing again becoming profitable, sugar remained the staple product of the Island for nearly 100 years. At the end of that period there were some 56 estates under cultivation. At the close of the nineteenth century however, cane cultivation was rapidly giving place to Cacao until at the present time there is only one factory of any importance left working.

Cane production in Tobago is peculiar. Through a combination of the absence of capital and lack of labour, Cruickshank in 1845 instituted the "Metayer System". This is a system in which the land is retained by the estate, but the cane is grown by farmers for half the proceeds. This method of cultivation has persisted to the present day.

Position of the Area.

The geographical position and the geological formation of Tobago have formed the subject of a recent paper by Hardy, Akhurst and Griffith (1931). Though formerly sugar was grown in most of the river valleys of the windward coast, it is now confined to the area of undulating land north-west of Scarborough, the capital town, and in the neighbourhood of Plymouth.

Varieties Grown.

The factories are archaic, manufacturing for local use a crude sugar by the open pan method. Orange Hill (Mr. Clarke Crooks, Manager), the largest remaining factory, produces annually about 400 barrels.* Only the old soft varieties of cane are therefore suitable, and " Bourbon " cane and another kind known locally as " Transparent " cane are the chief varieties cultivated. B.H.10(12) is at present being grown experimentally. Uba was introduced but was used only as stock feed.

Insect Pests.

Though old ratoons are grown the Metayer System of cultivation prohibits the productions of large unbroken areas of cane and perhaps this is why insect damage is not serious. A comparison with the conditions in the neighbouring island of Trinidad, where cane is grown under estate conditions, may however not be without interest.

Froghopper.—The Tobago froghopper, *Tomaspis carmodyi* Kershaw, is very similar to, though considered specifically distinct from, the destructive Trinidad froghopper *Tomaspis saccharina* Dist. This species was described by Kershaw in 1913, and was then considered to be confined to Tobago. It has however been recently suggested that this species may also occur on the North Coast of Trinidad (China and Myers 1934).

The host relations of the two species appear to be very similar. Up to the present time *T. carmodyi* nymphs have been found feeding on the wild grasses *Paspalum polygonatum*, *Axonopus compressus* and the introduced *Eleusine indica*; it has not yet been collected from sedges. In a future article the host and habitat relations of both the Trinidad and Tobago species will be discussed more fully.

T. carmodyi has never been known to cause blight on cane (Williams 1921), but on a recent visit to the small sugar cultivations of the island, the adult froghoppers were found to be tolerably abundant in the funnels of the leaves, and spittle masses were found at the base of a few stools. No apparent damage however had been done to the plants and the insect was not sufficiently in evidence even to have been noticed by the growers.

In 1927 however, Mr. Crosby, manager of Adventure Estate, informed the writer that there was a considerable outbreak of froghoppers on Uba cane at Friendship Estate. At the time it was considered that this was due to the Trinidad species which was supposed to have been imported with the Uba plants which came from that island.

Whether or not this was due to the imported or endemic species remains a question, and there has since been no recurrence of the attack. The disappearance of these alleged introduced froghoppers and subsequent freedom from attack are attributed locally to the abundance of frogs, chiefly *Hyla* spp., *Eupemphix* sp. and *Bufo marinus*, and also to birds such as the boat-tail (*Holoquiscalus*), the merle corbeau (*Crotophaga*), bush guinea bird (*Thamnophilus*), scissor-tail (*Muscivora*), grey headed kiskadee (*Tyrannus*), mocking bird (*Mimus*), swallows (*Hirundinidae*), and swifts (*Micropodidae*), all of which are extremely abundant. No critical stomach examinations were made to substantiate this theory, it is however interesting to record that the Tobago planters appreciate the usefulness of these natural controlling agents.

Moth Borers.—The only insect pest recognised as such by the Tobago planters are Moth Borers of the genus *Diatraea*. Though dead hearts are probably as numerous there as in Trinidad and the soft varieties of cane grown are rather susceptible to borer attack, little actual damage is felt since the extraction of juice from the cane is in any case not very efficient.

A careful search for larvae on Adventure Estate resulted in 12 being found which have all been provisionally determined from larval characters as *Diatraea canella*, and the one adult reared was certainly this species. The great majority of the borings contained pupae which had already emerged, though in one case the empty puparium of a parasitic fly, probably *Stomatodexia*, was found.

In conclusion it may be stated that the entomological conditions in the Tobago cane fields are very similar to those prevailing in Trinidad.

The froghopper there, a related species to the Trinidad form, has the same habits but is not sufficiently abundant to cause blight.

The moth borer there is represented by *D. canella* which is, with *D. impersonatella*, the common species in Trinidad cane, though in many other islands *D. saccharalis* is the prevalent form.

References.

China, W. E. and Myers, J. G.—Critical notes on some Neotropical species of *Tomaspis*.—*Ann. and Mag. Nat. Hist.* Ser. 10, Vol. XIV, p. 448, 1934.

Hardy, F., Akhurst, C. G. and Griffith, G.—The Cacao Soils of Tobago. Supplement to *Tropical Agriculture*. February, 1931.

Hay, L. G.— A Handbook to the Island of Tobago. Georgetown, Demerara. 1899.

Kershaw, J. C.—Froghoppers. *Special circular No.* 6. Dept. Agric. Trinidad and Tobago. 1913.

Kershaw, J. C.—A New Froghopper from Tobago. *Bulletin Ent. Res.* IV., p. 143. 1913.

Williams, C. B.—Report on the Froghopper Blight on Sugar-Cane in Trinidad.—*Mem. Dept. Agric. Trinidad and Tobago*. No. 1. 1921.

* A barrel of sugar weighs 400 lb. and is sold for about $9.00. (1935.)

THE PROPAGATION OF CUTTINGS IN TROPICAL CLIMATES.

By E. E. Cheesman and G. E. L. Spencer.

In the course of researches into the possibilities of establishing cacao clones on their own roots, a simple technique has been developed at the Imperial College of Tropical Agriculture which has given excellent results with many other plants, and would appear to merit trial in other countries having similar conditions.

The method employs softwood or semi-hardwood cuttings, having their leaves on, and at the outset it may be stated that such cuttings seem to be much more suitable than leafless hardwood for the majority of tropical species. It seems probable that the relatively uniform high temperatures of an insular tropical climate, and the absence in nearly all woody species under such conditions of any prolonged resting phase, prevent the accumulation of reserves at all comparable with those of deciduous species in a temperate climate. However this may be, our experience is that young leafy material is always easier to root than older leafless shoots, and that even in species which root fairly easily from hardwood the plants raised from softwood are usually more vigorous and satisfactory.

In the leafy cutting there can be little doubt that scanty reserves are supplemented by photosynthesis, going on all through the rooting process. Therefore from the physiological point of view the problem of propagation resolves itself mainly into one of providing conditions under which the leaves will be retained and will function healthily. This is widely recognized in horticultural practice, only the means of attaining the desired end are better known in temperate than in tropical garden tradition. The worker in the Tropics, or at least in those parts of the Tropics that have an insular climate, has one great advantage in that he needs no elaborate control of temperature. His problem is thus reduced to one of water-balance, for the control of which some form of propagator is essential with the more difficult species, and facilitates the handling even of those species which will root from cuttings in the open ground. The fact that leafy shoots of several species difficult to root have been kept fresh and green in the I.C.T.A. propagators for periods up to eight or nine months indicates that the apparatus provides an almost ideal environment for cut shoots. In the case of *Citrus*, single leaves have remained fresh for an equal length of time. This goes at least half-way to the solution of propagation problems, since our experience suggests that the majority of species will ultimately root if they can only be kept alive. The stimulation of root formation in the minority of really difficult subjects is a separate question, with which we make no attempt to deal in this paper.

The I.C.T.A. Propagator.

The propagator is essentially a concrete bin three feet long by two feet six inches, with a slightly sloping lid, the back being three feet above ground level and the front two feet ten inches. The height is determined solely by convenience in setting the cuttings. The sand bed, six inches deep, is raised to a minimum of one foot from the lid by filling the bottom of the bin with large stones and gravel. A drainage hole is provided at the bottom. For economy of construction the bins are built in banks of 12, arranged back to back in two rows of six. (Plate I, fig. 1.)

The lids are glazed, but we have made trials with a calico-covered frame which gave good results, and the use of glass is certainly not essential. The fabric lid has the advantage of being much lighter in weight than the glass lid, not only on account of the fabric itself, but because the supporting wooden frame can be made much lighter. The calico develops moulds after a time and needs renewal.

The lids are not hinged, but are provided with handles on the top as well as at the front, so that they can easily be lifted right off the bin. (Plate I, fig. 2.)

The bins are covered with a canopy of light angle-iron and stout wire, which should ideally project at the sides and ends sufficiently to shade the bins at all hours of the day and all seasons of the year. It saves space, however, to reduce the overhang and use side-curtains east and west to cut off morning and evening sun. The top, like the curtains, is of calico, which seems to give just the right amount of shade. Palm leaves, and alternate strips of roofing felt and a glass substitute have been tried, the former giving too dense a shade besides harbouring vermin, the latter proving too expensive in renewals.

The glass lids are covered with a double layer of cheese-cloth, which, combined with the calico shade, does not cut off too much light. This is kept wet during the day, and evaporation from it cools the air in the interior of the propagator by as much as 5-6°C. with evident benefit to the cuttings. This is the only measure taken to control temperature in any way.

The rooting medium used is a coarse-grained calcareous sand from a sea-beach, and since its adoption in 1931 it has consistently given better results than any of several other rooting media tried. Much of the original sand is still in service and does not seem to deteriorate in any way from constant use. Moss rarely grows on it, and only when it remains undisturbed longer than the average rooting requires. *Citrus* spp. alone have consistently given better results in a finer sand.

Physiological Factors.

Temperature.

A maximum sand temperature of about 28°C. is reached in the late afternoon, and a minimum of about 26°C. in the morning around 7 a.m. The fluctuation is not enough to have any seriously detrimental results, and the mean is comparable with that attained in temperate gardens by artificial heating.

Water Supply.

The water supply is intimately connected with the aeration of the medium, and that in its turn with texture. The chief value of our coarse sand probably lies in the fact that with adequate drainage underneath it is practically impossible to make it too wet. Adjustment of the water content therefore calls for little skill, and is effected by watering sufficiently frequently to avoid the least risk of drying out. Waterings at 8.00 a.m., noon, and 4.00 p.m. are given in practice, and either a can or a hose can be used, with a fine rose in each case. Water is added till it runs out through the drainage hole. The finer sand which has to be used for *Citrus* spp. demands more care in water control, and is watered only once every other day, in the morning.

Atmospheric Humidity.

With the lids closed, the air round the cuttings must be practically saturated with water, and this seems to be the required condition, since experiments with partially lifted lids have never shown any advantage from a lower humidity or increased ventilation. The result is to be expected from the consideration that water uptake by the shoot through a callussed cut cannot be sufficient to balance more than a very low rate of transpiration

Light.

The factor which calls for the most careful attention is the illumination. Direct sunlight is detrimental, either because it raises the temperature above the optimum or because of its influence on transpiration, probably on both accounts. Too heavy shade, on the other hand, reduces photosynthesis and leads to abscission of the leaves and consequent death of the cutting in all but the easiest rooting species. The ideal is almost certainly the maximum light that can be given without either raising the temperature or unduly stimulating transpiration. The correct adjustment of shade has in practice to be made by trial and error, but the optimum for one species (*Theobroma cacao*) seems to be suitable for the majority. *Citrus* spp. not only tolerate but benefit from, a higher light intensity and for them no cheese-cloth is used over the glass lids.

Material for Rooting.

Given a suitable environment within the propagators, the greatest factor in successful propagation of most species appears to be the physiological condition of the cutting at the time it is taken. Our observations in this connection are entirely empirical, but may be given for what they are worth. Shoots actually in the act of making a flush of new growth are not particularly suitable, and in cases where the young flush is very soft it may die back. Such shoots are, however, better than those which are dormant and carry senile, inefficient leaves. The best stage in most cases is probably immediately at the end of a flush, when the leaves are fully expanded, but still quite young.

It perhaps scarcely needs mentioning that only healthy material is worth taking since any fungal infection or insects such as thrips will increase in the humid atmosphere of the propagator. Apart from this, it is noteworthy how little trouble is caused by disease in the bins. Presumably the absence of organic matter in the sand is largely responsible for discouraging fungi, and perhaps the calcareous fraction plays a part by preventing the development of any acidity. The rapid growth of callus on the cut ends of stems that are largely parenchymatous also tends to protection from invading organisms. Whatever the reason, it is very rare for any softwood cutting to rot under the conditions provided.

A more common trouble is leaf-abscission, and this has been traced to several causes. Sometimes it is due to too much shade, as mentioned above. Particularly in the case of cacao cuttings it is often traceable to thrips attack prior to setting. At other times, however, the only reason that can be suggested is failure of adequate uptake of water due either to blocking of the cut end, or to some obstruction of the conducting tracts. It may be suggested, though without critical evidence, that the obstruction in some cases at least is air drawn in by a rapidly transpiring shoot when cut from the parent plant. At all events, it is recommended that cuttings of species not easy to root should whenever possible be collected in the morning, when their turgor is high, and be placed at once in water, taken to the tree for the purpose, so that they may be set in the sand fully turgid. When material has perforce to be carried some distance and arrives even slightly flaccid, it should be kept in water till turgid. A fresh cut is, of course, always made at the time of setting.

Treatment after Rooting.

Among other advantages of softwood over hardwood cuttings is the fact that they usually form roots before making any new shoot growth, whereas hardwood cuttings tend to do the reverse. The advantage is that if potting is carried out soon after rooting, no new leaves are developed under the very moist conditions of the propagating bin. No hardening-off process, in the strict sense of the term, is therefore involved, before the rooted cuttings are put in the field. It remains necessary, however, to guard against excessive transpiration until the root system is well grown.

PROPAGATION OF CUTTINGS IN TROPICAL CLIMATES.

PLATE I.

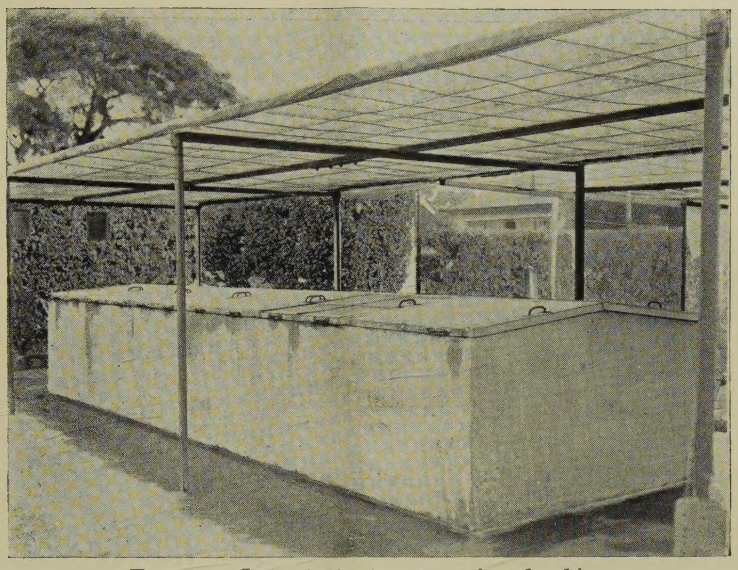

FIG. 1.—*Concrete propagator, of twelve bins.*

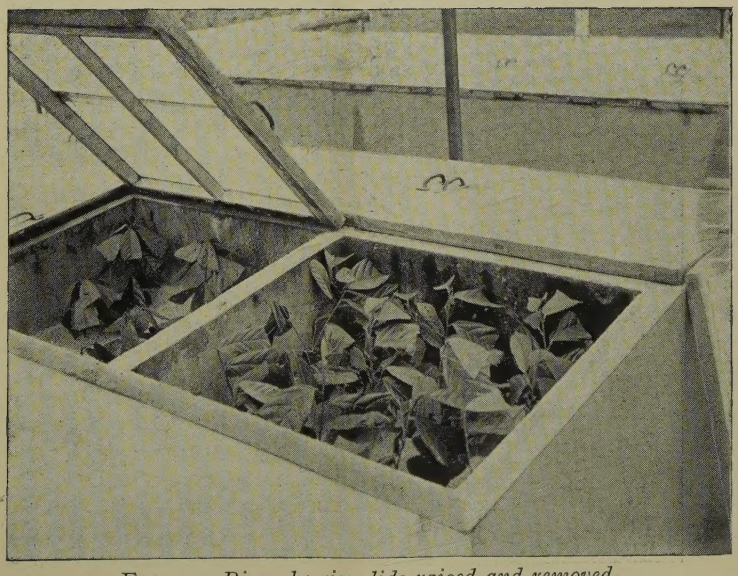

FIG. 2.—*Bins showing lids raised and removed.*

PROPAGATION OF CUTTINGS IN TROPICAL CLIMATES.

PLATE II.

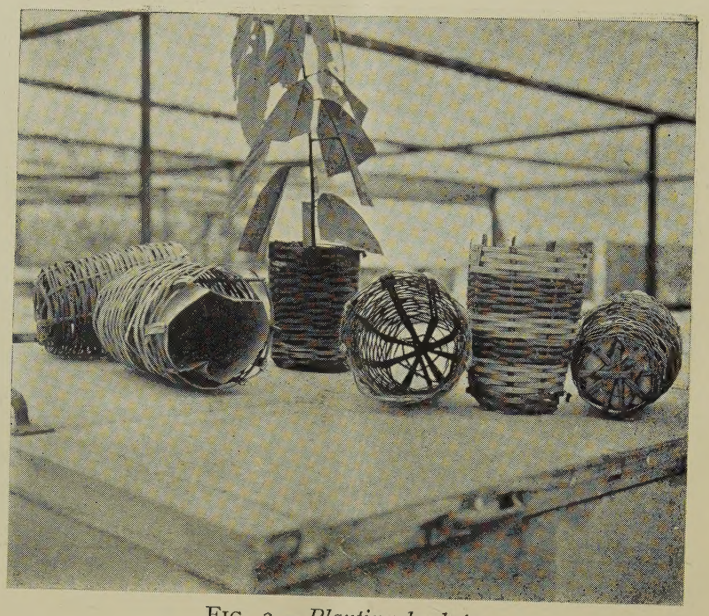

FIG. 3.—*Planting baskets.*

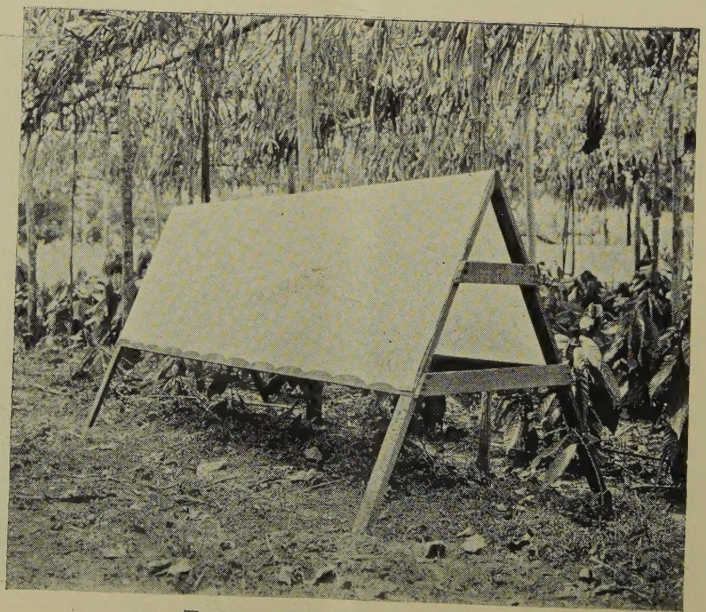

FIG. 4.—*Portable canvas shade*

For many purposes we find it convenient to employ loosely woven baskets of about the same capacity as a six-inch pot*. These baskets are locally made of "tirite" (*Ischnosiphon Arouma*). (Plate II, fig. 3.) It is convenient in filling them to line them with paper, which quickly rots away. The potting mixture is made up of two parts loam, one part sifted cow dung and one part coarse sand, the same as that used in the bins. Subsequent treatment varies with the species concerned. In cases, of which cacao is an example, where the young roots are brittle, the cuttings are transferred to the baskets at an early stage of rooting to minimize injury. The baskets are then placed in an empty propagating bin, and the lid kept closed until roots appear through the sides, which may be within a week or may be longer. As soon as roots come through, indicating that a certain minimum root system has been established, the plants may be set outdoors. In cases where the roots are more fibrous the cuttings can be left in the sand until the root system is well developed. The baskets need then only be placed under shade until the cuttings recover from their transplanting, or they may be placed at first in a closed bin, and the lid raised by degrees after a few days until they are fully exposed. The basket is set in the ground as it is, but only to half its depth to allow for subsequent sinking of the light compost within. Artificial shade is often desirable for the first few days after planting. For this purpose light frames of wood covered with calico are used, and the most convenient pattern is a span-roof type. (Plate II, fig. 4.)

Species Rooted.

The list of species actually rooted in this propagator is a long one, and contains many that can be rooted by other means, because we find that the speed and certainty of its results and the convenient concentration of material in a small space justify its use even for species that can be struck in the open ground. Almost any species that can be marcotted can be rooted with greater ease in the propagator and will give a more shapely and more vigorous plant.

Apart from *Theobroma cacao*, for which it was developed, we may mention *Achras zapota*, *Camellia sinensis*, *Citrus* spp., *Coffea* spp., *Cola acuminata*, *Eugenia uniflora*, *Flacourtia indica*, *Gossypium* spp. and *Myristica fragrans* among economic plants in which vegetative propagation by cuttings may be desirable at times for experimental work even if not for commercial use. The last named was only rooted once, and no practical success can be claimed with it, but the result is interesting as showing possibilities in further work. *Achras zapota* gave only a few successes, but the remainder of the species rooted with comparative ease. Among the common ornamentals of tropical gardens, very few out of some dozens tried on a small scale have failed. No systematic attack has been possible on the more obstinate of the fruit-tree species, owing to preoccupation with the major crops on our research programme, but the sum of our experience suggests that very few will ultimately fail to be rooted by this or a similar technique, and it is hoped that the description given will be sufficient for workers who may wish to try its extension to species in which they are interested.

* Similar baskets are used in the Botanic Gardens in Georgetown, British Guiana, and we are indebted to Professor J. S. Dash and Mr. E. B. Martyn for specimens and details of their construction.

PLANT VIRUS PROBLEMS.

An address on this subject was given by Dr. Kenneth Smith before Section K at the Norwich meeting of the Britsh Association and is published in *Science Progress*, 30, No. 119, January 1936. Dr. Kenneth Smith, referring to the 'breaking' or variegation of self-coloured tulips, which has been shown to be due to an insect-propagated virus disease, makes the very interesting suggestion that virus infection may be widespread as a cause of flower variegation. Inoculation from the petals of variegated violas has produced virulent mosaic diseases in healthy tobacco plants; there is obviously an enormous field of work opening here of exceptional interest to the horticulturist, who may yet be found inoculating flower strains to obtain interesting variegated forms. The insect transmission of virus disease is discussed. Their transmission is often closely linked with the sap-sucking Hemiptera, and the relation of the virus to the insect carrier raises many points of interest. Dr. Storey's observation of the existence of two strains of leafhopper in East Africa, indistinguishable to the eye but one transmitting the streak disease, the other not, is full of interest, and notably his further observation that the inactive strain will transmit the virus after the wall of the gut has been punctured. The mechanism of movement of the virus is discussed and its slow propagation in living parenchyma and comparatively rapid propagation in living phloem emphasised. A comparative diagram of sizes of virus organisms and of protein molecules, based upon ultra-filtration through specially prepared collodion membranes, lends emphasis to the recent claim of Dr. Stanley of the Rockfeller Institute, to have crystallised out the virus of tobacco mosaic which he therefore concludes is an autocatalytic protein. Certainly autocatalytic production of the virus organism would be a natural assumption to explain the extraordinarily interesting production of a special virus in the roots of tobacco plants, which are quite healthy in the seedlings and yet, grown in sterile soil, later develop a virus which remains located in the roots until it develops symptoms in some of the lower leaves.—(*Nature*, Vol. CXXXVII, No. 3463, p. 463, 1936.)

THE BRITISH WEST INDIES CENTRAL SUGAR CANE BREEDING STATION, BARBADOS, B.W.I.

An Account of its History and Work.

By A. E. S. McIntosh, B.Sc., Ph.D.,
Geneticist.

Historical.

The first authentic discovery of sugar cane reproduction by true seed in Barbados was made in 1878. Eleven years later, in 1889, the commercial possibilities of this discovery were realised, and a start made by Harrison and Bovell in raising and selecting sugar cane seedlings. From that time, sugar cane breeding has gone on in Barbados uninterruptedly up to the present day.

The best of the seedlings produced were quickly taken up by the other sugar cane growing colonies in the British West Indies, and were found, in spite of no special breeding and selection work, to be successful in the majority of these areas.

The West Indian Conference of Agricultural Officers, held at the Imperial College of Tropical Agriculture in Trinidad in January 1930, made the following recommendation:—

"The Conference considered the question of centralizing the work of breeding commercial varieties of cane. It was definitely of the opinion that at least two stations for the Caribbean area would be required, one in British Guiana, a colony of unique conditions, and the other in Barbados, a historic station which had produced varieties of proved value to the neighbouring Islands. In this connection the Conference desired to place on record its appreciation of the benefit to the West Indies in general of the cane breeding work carried out by the Barbados Department of Science and Agriculture, and expressed the opinion that it was highly desirable that this work should be continued and strengthened."

The Sugar Cane Research Conference held in London in August 1931, amplified this recommendation, and a grant of £2,000 was made by the Imperial Government in the same year towards the upkeep of the station.

Proposals were made to establish a Central Sugar Cane Breeding Station for the British West Indies in Barbados, and these proposals were approved by the Colonial Office, and the Station opened in November 1932.

No direct financial assistance was given to Barbados, but an annual grant of approximately £2,000 was made from the Empire Marketing Board (and later from the Colonial Development Fund) towards the cost of extending the cane breeding work to include the production of sugar cane seedlings for Jamaica, Trinidad and the Windward and Leeward Islands.

From 1st October, 1936, these colonies will contribute half the cost of the Station, apart from the £5,500 annually contributed by Barbados thus:—

	£	s.	d.
Trinidad	500	0	0
Jamaica	262	10	0
Leeward Islands....	212	10	0
Windward Islands	25	0	0
	1,000	0	0

After 1st October, 1937, the full £2,000 will become a charge on the contributing colonies.

It was realised that the islands concerned should have an opportunity of reviewing the work at regular intervals, and that the closest co-operation should exist in matters of receiving and testing seedlings produced by the Station. To this end an Advisory Committee was appointed under the Chairmanship of the Director of Agriculture of Barbados, together with the Principal of the Imperial College of Tropical Agriculture, the Director of Agriculture of Trinidad, the Director of Agriculture of Jamaica, and the Commissioner of Agriculture of the Windward and Leeward Islands. The functions of this Committee are purely advisory, and have reference in particular to the policy of the scientific work of the Station.

A Review of the Sugar Cane Seedling Requirements of the British West Indies and the General Schemes Adopted in Breeding and Selecting Seedlings for these Areas.

With a view to obtaining general ideas as to what type of seedlings were most likely to succeed in the various islands and so formulating definite schemes of breeding in the expansion of the work consequent on the formation of the Station, the writer visited the sugar cane growing areas in St. Kitts, Antigua (twice), Trinidad, Jamaica, St. Lucia and Grenada. Accounts of these visits, with conclusions as to the seedling requirements, have been published from time to time in *Bulletins* of the Station (1, 2, 3, 4, 5). For purposes of this article, a classification of these requirements is made here. This classification is not necessarily regarded as finite—since it will undoubtedly be altered with further knowledge and experience with seedlings produced by the Station and tested in the various areas—but it is considered to provide a reasonable working basis for the near future.

A chart showing this classification and the general schemes of breeding and testing is also shown (Chart I). These are explained here.

A.—Thick Cane Areas.

These areas possess soils of at least reasonably good natural or induced fertility, a good water supply, either through direct rainfall or irrigation, and are given good agricultural treatment. It has been shown by experience that such areas are best suited economically to the growth of thick canes.

These areas are sub-divided into two, *i.e.* (*a*) where mosaic disease is not of major importance, and (*b*) where mosaic disease is present and its control impracticable.

(*a*) *Where Mosaic Disease is not of Major Importance.*

Such areas are present throughout Barbados, St. Kitts, St. Lucia, Grenada and a large part of the Jamaica sugar cane areas. In Trinidad, they are present at Woodford Lodge, Reform, parts of Caroni, Waterloo, Orange Grove, Brechin Castle Estates and the black limestone soils of the Usine Ste. Madeleine. In Antigua, they occur over the Antigua limestone soils, the calcareous clay tuffs and the alluvial soils.

These areas constitute by far the greater part of the entire sugar cane lands served from the Station, and it is naturally only right that the majority of the sugar cane breeding and seedling testing work should be done for them.

Details of the actual methods employed in breeding and testing sugar cane seedlings in Barbados have been published elsewhere (6, 7), and will not be considered here. It is necessary, however, to consider the range of seedling types required within these areas. At present, several sugar cane ecological units are recognised, differing from one another in the length of favourable growing season and the possible extent of ratooning. General requirements of seedlings over all these units are high yield of easily reaped and milled cane giving high sucrose return, resistance to gumming disease and various forms of cane and root rot, and in most cases, strong ratooning power. In addition, for each unit it is desirable to have seedlings which ripen at different periods during the crop season.

The length of the favourable growing season varies appreciably over the ecological units. Thus the duration of the favourable growing season may be *long* [greater part of Jamaica, Trinidad (Woodford Lodge, parts of Waterloo), St. Lucia (Roseau, Cul-de-Sac), greater part of Grenada,] or *intermediate* [Trinidad (black limestone soils of the Usine Ste. Madeleine, Reform, parts of Brechin Castle, Waterloo, Orange Grove), Barbados (red coral limestone soils), Jamaica (Llandovery, Richmond, Catherine Hall), St. Kitts (higher rainfall district), Antigua (alluvial soils and calcareous clay tuffs) St. Lucia (Dennery) and parts of Grenada,] or *short* [Barbados (black coral limestone soils), St. Kitts (low-rainfall district) Antigua (limestone soils) Jamaica (Rose Hall, Iron Shore, parts of Trelawney) St. Lucia (Vieux Fort) Grenada (Grand Anse). The factors influencing the length of favourable growing season need not be considered here, but it is of great importance to note that different types of sugar cane seedlings are required to fit into these different lengths of growing season. Thus, by way of illustration, B.2935 is a seedling for a short, B.726 for an intermediate, while B.H.10 (12) is one for a long favourable growing season.

In regard to breeding for those areas, it would appear that thick canes, belonging to the species *Saccharum officinarum*, when used as breeding material, are likely to give seedlings satisfying general requirements, and including a range of growth types, selections from which will provide early and late ripening seedlings suited to each of the various recognised ecological units.

Accordingly, in breeding at the Station for this most important category, thick canes only and chiefly Barbados varieties, are used. The ecological units noted in this category are for the greater part present in Barbados. It follows that seedling testing can be carried out in Barbados through the majority of stages in the routine of trial and selection, until finally seedlings are selected which are definitely promising as competitors of commercial standard varieties. In addition, by the scheme of trials and experiments conducted in Barbados, strong indications are obtained for each seedling eventually selected and despatched to the islands, of the ecological unit and reaping time to which it is suited. Further tests of seedlings in the receiving islands are therefore localised in tests in areas appropriate only to each seedling, as recommended by the Station.

The scheme of testing these seedlings in Barbados is outlined in Chart I. It is to be noted that gumming disease resistance tests are carried out in the early stages of seedling testing and susceptible seedlings are eliminated.

(*b*) *Where Mosaic Disease is present and its Control Impracticable.*

These areas are present in Jamaica. They constitute, for the greater part, areas whose soil and climatic conditions are eminently suited to growing thick cane seedlings. Were mosaic disease control feasible, such areas would come within the breeding policy of those noted above. Mosaic disease has, however, got beyond practical control measures, and the only apparent solution of the problem is to breed for resistance to mosaic disease.

It is evident that the growth-types of seedlings required here should be similar in agricultural characteristics to those noted in sub-section (*a*). In addition, however, they must possess commercial resistance to mosaic disease. The problem therefore is to produce thick cane seedlings of the desirable growth-type and resistant to mosaic disease.

CHART I.

BRITISH WEST INDIES CENTRAL CANE BREEDING STATION.

Chart to Illustrate the General Schemes of Breeding and Testing Seedlings in Barbados, for the British West Indies.

The Areas.	Breeding Material.	Scheme of Breeding. Oct.-Dec.	Testing and Selecting Seedlings.					
			Field Nursery. April-Oct.	First Year Seedling Test. Oct.-Year March.	Multiplication. Gumming Disease resistance and minor selection plots.	Second Year Trials.	Select Seedling Trials.	Variety Trials.
A.—Thick Cane Areas. (*i.e.* where growing conditions are at least reasonably good). (*a*) Where mosaic disease is not of major importance—Barbados, St. Kitts, St. Lucia, greater parts of Jamaica, Antigua and Trinidad.	Thick canes belonging to the species *Saccharum officinarum*.	Hybridisation between thick cane varieties (chiefly Barbados varieties). Approximately six proven crosses at present made, and in addition approximately ten experimental crosses whose progenies are tested in order to note if any is sufficiently good to be added to the above.	Approximately 10,000 seedlings planted.	Approximately 6,500 planted.	Approximately 100 selected and planted in above tests about March. These tests last approximately 20 months.	Approximately 60 tested. These selections sent to Plant Quarantine Station at conclusion of second year tests. While being quarantined, they are further tested in Barbados when fuller information is obtained for each, before real release for trial outside Barbados.	Approximately 6 tested.	Approximately 1 to 3 tested.
(*b*) Where mosaic disease control is impracticable in thick cane areas, *e.g.*, considerable percentage of Jamaica sugar cane lands.	Java varieties of varying degrees of *glagah* (*Saccharum spontaneum*) nobilisation and varieties of species *Saccharum officinarum* (chiefly Barbados varieties).	Nobilisation of Java 'glagah' — *Saccharum spontaneum*, chiefly with Barbados noble varieties.	Approximately 2,500 seedlings planted.	Approximately 2,000 planted.	Approximately 50 planted. (Mar.-Nov. of same year).	Approximately 30 tested.	Selections from these tests sent to Plant Quarantine Station and not further tested in Barbados.	
B.—Areas with poor growing conditions—parts of Trinidad, Antigua, Jamaica.	Indian varieties of *Saccharum spontaneum*, Uba—*Saccharum sinense*, and North Indian varieties, *Saccharum barberi* and their early nobilisations.	Nobilisation of these by crossing chiefly with Barbados varieties of *Saccharum officinarum* and crossing derivatives between themselves.	Approximately 2,500 seedlings planted.	Approximately 1,500 planted.	Approximately 35 planted. (Mar.-Nov. of same year).	Approximately 20 tested.		
C.—Froghopper Areas.	Consignments of fuzz from a large variety of crosses sent to Trinidad for froghopper resistance tests on resultant seedling populations.							

All thick canes belonging to the species *Saccharum officinarum* would appear to be susceptible to a greater or less extent. Commercial resistance and even complete immunity is met with in the species *Saccharum spontaneum* (var. *Glagah*, from Java) and *Saccharum sinense* (Uba varieties). The former species, when crossed with thick cane varieties (a process known as " nobilisation "), has given very favourable results—notably in Java. When nobilisation of this wild species has been carried to the third and fourth degree, thick cane seedlings of great commercial value and commercial resistance to mosaic disease have been produced (*e.g.*, P.O.J. 2725, P.O.J. 2878).

Breeding for this category at the Station consists in the further nobilisation of Java varieties, which themselves resulted from the nobilisation of the wild Java *Glagah*. The chief feature for selection in these seedlings—apart from the obvious one of resistance to mosaic—is the possession of a type of growth suited to the long favourable growing season in Jamaica. Many seedlings derived from nobilisation of Java *Glagah* tend to be short-season types. It is the experience in the British West Indies that such types are unsuitable to areas with a long favourable growing season, and are preferred to long-season Barbados seedlings only on account of their resistance to mosaic.

This part of the nobilisation work at the Station has already been taken to the fourth and fifth degree, and longer-season types are appearing in the progenies. The seedlings selected from the first year trial are given a second season's trial in Barbados against standard Barbados commercial varieties. Selections from these trials are then to be sent to Jamaica for mosaic disease resistance tests and subsequent field trial of the survivors from these tests.

B.—Areas with Poor Growing Conditions.

Such areas are charactised by the possession of intrinsically infertile soils. Soil texture is poor, the nutrient status very often low, and the reaction very acid or markedly alkaline. Water-logging is a common feature. With regard to sugar cane seedling types, thick canes, while perhaps giving a good plant-cane crop, fail as ratooners. Wild canes such as Uba (*Saccharum sinense*) or seedlings of lower degrees of nobilisation such as Co.213 and P.O.J. 2727 alone appear to succeed in that they give good cane yields and ratoon successfully.

These areas are present in Trinidad [parts of Caroni, Esperanza, Brechin Castle, Waterloo, Orange Grove, Usine Ste. Madeleine (red weathering clay soils)], in Antigua (non-calcareous and saline clay tuffs) and in Jamaica [parts of Vere and St. Catherine (saline areas) and parts of Trelawney (soil with a high percentage of " shot ")].

The chief necessity of seedlings for these areas would appear to be strong root development, even under the unfavourable soil conditions of bad aeration and frequent water-logging. At present the varieties which are of necessity grown in those areas, while giving good cane yields and ratooning very well, have many undesirable characteristics. They are thin canes, difficult to reap and costly to handle. In many cases they necessitate burning to clear them of trash, with a consequent loss of valuable humus-forming material. They provide difficulties in milling, and require in many cases to be left as standover canes, since they tend to be late in ripening.

The chief aim in breeding for those areas is the production of seedlings whose growth-vigour is no less than the existing commercial types, but which are an improvement on the commercial types in the above noted inferior characteristics. With this end in view, a start has been made at the Station to nobilise or further nobilise species and seedlings which possess the necessary growth-vigour and powers of persisting—as shown by strong ratooning—under such conditions. In nobilisation, the noble-cane varieties used as parents are Barbados seedlings. These are being crossed with (*a*) Uba (*Saccharum sinense*) (*b*) Indian varieties of *Saccharum barberi*, (*c*) the Indian form and the Celebes form of *Saccharum spontaneum*, and (*d*) commercial varieties such as Co.213.

Seedlings from these nobilisation schemes which are eventually selected from First Year Seedling Trials in Barbados are tested for their general standard against Co.213 in a second year trial in Barbados. Selections from this trial are sent to appropriate areas for further test.

C.—Froghopper Areas.

These occur in Trinidad. The question of breeding for resistance to froghopper has recently been considered, and preliminary investigations into the possibilities of this are being carried out. At present investigations are being carried out in Trinidad into the nature of an already observed varietal resistance to froghopper.

A consignment of fuzz from crosses derived from a wide range of parent material was despatched to Trinidad at the end of the 1935 breeding season. Seedlings from this fuzz are being raised in Trinidad, and will be tested in natural or artificially induced froghopper conditions with the following main objects in view:—(1), to note the nature of resistance, and more particularly if resistance can be associated with any readily recognizable seedling characteristic, and (2) to note if resistance is a hereditary characteristic. Both those objects have in view the guidance of the breeding work at the Station for this particular category.

The Routine Method Employed in Despatching Seedlings to the Islands Concerned.

Cuttings of seedlings selected in Barbados for possible subsequent test in other islands are despatched, after certain hygienic treatments, to the Plant Quarantine Station in Trinidad. Here they are quarantined for a period. During

the time that seedlings selected for thick cane areas where mosaic is not of major importance are undergoing quarantine, they are being further tested in Barbados. Thus, by the time these have passed through quarantine, further information is available for each.

At the conclusion of quarantine, the Central Sugar Cane Breeding Station is notified, and in turn notifies the Plant Quarantine Station to which islands each seedling should be sent.

The Central Sugar Cane Breeding Station provides each island with notes on each seedling received and suggestions as to its location in future field trials.

Trials in the Islands.

As far as is practicable, uniform types of seedling trials are conducted throughout the islands.

The Central Sugar Cane Breeding Station is informed twice in any one year as to the progress and results of trials. This scheme is mutually advantageous in that it serves to guide the breeding and selection work, and acts as a check on the forecasts about each seedling issued by the Station. It is only through the closest co-operation between the work of the Station and the islands concerned that the best results will be achieved.

Notes on Seedlings Despatched to Date from the Central Sugar Cane Breeding Station to the Plant Quarantine Station.

In Chart II the seedlings despatched to date to the Plant Quarantine Station are listed with notes on their tests in Barbados and remarks on each. All seedlings are given the symbol—B—and a number, the first two figures of which indicate, for any seedling, the year of selection in its First Year Seedling Trial, while the remaining numbers identify the selections of any one year. It is to be noted that seedlings appearing under head—A—comprise selections from First Year Seedling Trials in 1929—three years before the Central Sugar Cane Breeding Station was established. These selections were made for Barbados conditions by the Barbados Department of Science and Agriculture, and they were included in the first consignment of cuttings from the Central Sugar Cane Breeding Station to the Plant Quarantine Station in November 1934. This first consignment could not be sent until the erection and functioning of the Plant Quarantine Station at the Imperial College of Tropical Agriculture.

The seedlings appearing on Chart II are classified under three heads—A, B and C. Under the first head—A—appear thick cane seedlings of noble variety parentage. These are intended for possible future trial in thick cane areas where mosaic disease is not of major importance. Under head B appear thick cane seedlings derived from Java *Glagah* nobilisations of the fourth degree; Barbados noble varieties being used in one or two degrees of the nobilisation process. These are intended for mosaic disease resistance tests in Jamaica and subsequent test of the survivors in thick cane areas in Jamaica where mosaic disease control is impracticable. Under head C are listed thin cane nobilisations with Barbados varieties. These are for subsequent test in areas with poor growing conditions.

The years of selection of these seedlings in second year trials in Barbados are noted in column three. It is to be noted that selections made under heads B and C undergo no further trials in Barbados and this for evident reasons. The extent of further testing in Barbados of seedlings under head A are noted. It is to be observed that seedlings under this head are now sent to the Plant Quarantine Station after selection in second year trials. This need not necessarily imply future test of all in the islands. Whether or no any seedling will be recommended for further test will depend on its further performance in more extensive Select Seedling Trials in Barbados. The latter take place in Barbados during the period of quarantine, and more precise information is available for each seedling. The object of sending these seedlings at selection after Second Year Tests is to shorten the time of reception by the islands of those surviving the Select Seedling Trials in Barbados. Thus, under the " Remarks " column, it can be seen that many of those seedlings are discarded in Barbados and are not recommended for test in the other islands. This rigid selection will admit of more comprehensive and more accurate testing of the fewer and more promising seedlings. Comparatively little in the way of forecast can be made for seedlings under heads B and C. For those under head A, however, short notes are here made on those whose performance in Barbados suggest considerable promise for certain ecological units in thick cane areas where mosaic disease is not of major importance.

*B.*2935.—This seedling is well adapted to giving high tonnages under short and medium lengths of favourable growing season. It gives definite promise of becoming a standard commercial variety in St. Kitts (lower-rainfall district), Antigua (limestone soils), St. Lucia (Vieux Fort), Grenada (Grand Anse) and small parts of Jamaica (lower-rainfall, unirrigated areas). This seedling is now the standard commercial variety in the lower and lower-intermediate rainfall shallow black coral limestone areas in Barbados.

B.3013.—This seedling gives a high yield of cane of excellent sucrose content in areas of medium to long favourable growing conditions. Under such conditions it ratoons very well. It ripens later than B.726 but appreciably earlier than B.H.10(12), and retains its tonnage very well during the crop season. It is easily reaped. This seedling has considerable promise for areas in Trinidad [Woodford Lodge, parts of Waterloo, Caroni, Orange Grove, Brechin Castle, Reform

CHART II.

BRITISH WEST INDIES CENTRAL CANE BREEDING STATION.

Chart showing Progress up to the present Crop Season (1936) of Seedlings selected in Second Year Seedling Trials.

A.—THICK-CANES (*Saccharum officinarum*).

Seedling.	Parentage.	Date of selection in second year trials.	Season and number of tests in select seedling trials.		Season and number of tests in variety trials.		Date of despatch to Plant Quarantine Station.	Remarks.
			Plant Canes.	1st Ratoons.	Plant Canes.	1st Ratoons.		
B. 2901 ..	B. 381 (open arrow) ..	1931	1931/33- 2	..	..	..	..	Discarded.
B. 2919 ..	Ba. 11569 x B.H. 10 (12)..	1931	1931/33- 3	..	..	..	..	Discarded.
B. 2931 ..	Ba. 11569 x B.H. 10 (12)..	1931	1931/33- 5	1934-3	..	..	Nov. 1934	Now discarded in Barbados and not recommended for test in the British West Indies.
B. 2935 ..	Ba. 11569 x Ba. 6032 ..	1931	1931/33- 8 1932/34-10 1933/35-10 1934/36-10	1934-6 1935-4 1936-5	1932/34-12 1934/36- 2	1935-4	Nov. 1934	In Barbados recommended in 1934 as a plant cane variety for lower-rainfall black-soil areas. At present undergoing tests in St. Kitts, Antigua and St. Lucia and grown on a small scale in Grenada. To be recommended for trial in lower-rainfall thick cane areas in Jamaica.
B. 2937 ..	Ba. 11569 (open arrow) ..	1931	1931/33- 2	..	..	..	..	Discarded.
B. 2947 ..	B. 381 (open arrow) ..	1931	1931/33- 2	..	..	..	..	Discarded.
B. 2976 ..	Ba. 11569 x B.H. 10 (12)..	1931	1931/33- 2	..	..	..	..	Discarded.
B. 2977 ..	Ba. 11569 (open arow) ..	1931	1931/33- 1 1933/35- 3	..	..	..	Nov. 1934	Now discarded in Barbados and not recommended for test in the British West Indies.
B. 3011 ..	Ba. 11569 (open arrow) ..	1932	1932/34- 1 1933/35- 4	1935-1	..	..	Nov. 1934	Now discarded in Barbados and not recommended for test in the British West Indies.
B. 3013 ..	Ba. 11569 (open arrow) ..	1932	1932/34- 6 1933/35- 7	1935-3 1936-6	1934/36-14	..	Nov. 1934	Shows distinct commercial possibilities. To be further tested in Barbados and recommended for inclusion in trials throughout the thick cane areas in the British West Indies.
B. 3063 ..	Ba. 11569 x B.H. 10 (12)..	1932	1932/34- 6	..	..	..	..	Discarded.
B. 3078 ..	B. 606 (open arrow) ..	1932	1932/34- 4	..	..	..	..	Discarded.

A.—THICK-CANES (*Saccharum officinarum*).—*Contd.*

Seedling.	Parentage.	Date of selection in second year trials.	Season and number of tests in select seedling trials.		Season and number of tests in variety trials.		Date of despatch to Plant Quarantine Station.	Remarks.
			Plant Canes.	1st Ratoons.	Plant Canes.	1st Ratoons.		
B. 3124 ...	Ba. 11569 x B. 417 ...	1933	1933/35- 6 1934/36- 5	1936-3	...	...	Nov. 1934	Shows some promise as an early variety for lower-rainfall thick cane areas in the British West Indies. Being tested for this purpose in variety trials in Barbados during season, 1935/37.
B. 3125 ..	Ba. 11569 x B.H. 10 (12)..	1933	1933/35- 8 1934/36- 5	1936-7	...	...	Nov. 1934	To be discarded in Barbados. Recommended for test in smaller trials in higher-rainfall thick cane areas in the British West Indies.
B. 3127 ..	Ba. 11569 x B.H. 10 (12)..	1933	1933/35- 9 1934/36-15	1936-5	...	...	Nov. 1934	Shows distinct commercial possibilities: particularly strong ratooning seedling. To be tested in variety trials in Barbados during season 1936/38 and recommended for trial throughout thick cane areas in the British West Indies.
B. 3138 ..	Ba. 11569 x B.H. 10 (12)..	1933	1933/35- 6 1934/36- 4	1936-3	...	...	Nov. 1934	To be discarded in Barbados. Recommended for test in smaller trials in thick cane areas in the British West Indies.
B. 3179 ..	Ba. 11569 x B.H. 10 (12)..	1933	1934/36- 9	...	...	..	Nov. 1934	To be discarded in Barbados and not recommended for test in the British West Indies.
B. 3216 ..	Ba. 11569 x B.H. 10 (12)..	1934	1934/36-15	...	...	..	Nov. 1934	Showed considerable promise, but too susceptible to Rind Fungus. To be discarded in Barbados and not recommended for test in the British West Indies.
B. 3234 ..	Ba. 11569 x B.H. 10 (12)..	1934	1934/36-11	..	1934/36-12	..	Nov. 1934	Shows promise of giving very high cane tonnages under very good growing conditions. Being further tested in Barbados and recommended for test in areas in the British West Indies with very good growing conditions.
B. 3239 ..	Ba. 11569 x B. 417 ...	1934	1934/36- 5	...	...	..	Nov. 1934	Will possibly be discarded.
B. 3259 ..	Ba. 11569 x B.H. 10 (12)..	1935	..	...	...	..	Sept. 1935	In select seedling trials 1935/37.
B. 3267 ..	Ba. 11569 x B.H. 10 (12)..	1935	..	...	...	..	Sept. 1935	
B. 3307 ..	Ba. 11569 x B. 417 ..	1936	..	...	...	..	To be sent during 1936	To be put into select seedling trials 1936/38.
B. 3327 ..	Ba. 11569 x B.H. 10 (12)...	1936	..	...	...	..		
B. 3439 ..	Ba. 11569 x Q. 813 ...	1936	..	..	..	..		

B.—Thick-Canes. Glagah nobilisations (*Saccharum officinarum* × *S. spontaneum*).—*Contd.*

Seedling.	Parentage.	Date of selection in second year trials.	Season and number of tests in select seedling trials.		Season and number of tests in variety trials.		Date of despatch to Plant Quarantine Station.	Remarks.
			Plant Canes.	1st Ratoons.	Plant Canes.	1st Ratoons		
B. 3172 ..	P.O.J. 2725 x B.H. 10 (12)	1933	..	..	..	..	Jan. 1936	To be sent to Jamaica for mosaic disease resistance tests and possible field trials.
B. 3215 ..	P.O.J. 2725 x B. 391 ..	1936	..	..	..	..	Sept. 1935	
B. 3254 ..	P.O.J. 2725 x B. 417 ..	1935	..	..	..	..	Sept. 1935	
B. 34105	Ba. 11569 x MD. 11 (=P.O.J. 2364 x B. 606)	1936	..	..	..	..	Jan. 1936	
B. 34106	MD. 47 (=P.O.J. 2364 x B. 606) x B.H. 10 (12)	1936	..	..	..	..	Jan. 1936	
B. 34110	MI. 20 (=P.O.J. 2364 x B. 605) x B.H. 10 (12)	1936	..	..	..	..	Jan. 1936	
B. 34120	Ba. 11569 x MB. 3 (= P.O.J. 2364 x B. 606)	1936	..	..	..	..	Jan. 1936	
B. 34129	ME. 72 (—P.O.J. 2364 x B. 374) x B. 2935	1936	..	..	..	..	Jan. 1936	
B. 34130	Ba. 11569 x MD. 11 [= P.O.J. 2364 x B.H. 10 (12)]	1936	..	..	..	..	Jan. 1936	
B. 34134	ME. 72 x B. 2935 ..	1936	..	..	..	..	Jan. 1936	
B. 34137	P.O.J. 2878 x B.H. 10 (12)	1936	..	..	..	..	Jan. 1936	
C.—Thin-Canes.								
B. 3337 ..	B. (30) L. 7=(P.O.J. 2364 x B. 391) : Self	1936	..	..	..	..	To be sent during 1936	For trial in areas with poor growing conditions. (*i.e.* parts of Antigua, Jamaica and Trinidad.)
B. 34104	Co. 281 x B.H. 10 (12)	1936	..	..	..	..	Jan. 1936	
B. 34117	P.O.J. 2725 x Co. 281 ..	1936	..	..	..	..	Jan. 1936	
B. 34163	Co. 281 x B.H. 10 (12) ..	1936	..	..	..	..	Jan. 1936	

Usine Ste. Madeleine (black marl soils)], Jamaica (in B.H.10(12) areas), St. Kitts (higher-rainfall district), Antigua (higher-rainfall portion of limestone soils, calcareous clay tuffs and alluvials), St. Lucia (Cul-de-Sac, Roseau, Choc and Dennery) and the greater part of Grenada.

*B.*3124. This is a seedling essentially adapted to early reaping in areas with short favourable growing seasons. It should be tested primarily as an early cane in areas suggested for B.2935 (q.v. above). It gives a cane tonnage slightly inferior to B.2935, but has an unusually high sucrose-in-cane early in crop. If kept too long during crop it tends to lose weight rapidly.

B.3127.—Indications are that this is the best general purpose seedling so far produced by the Station. This is on account of its adaptability to a range of conditions from short-medium to long favourable growing conditions, its soundness during crop, and its apparently very strong ratooning powers. It possesses a juice quality equal to B.H.10(12), and it ripens somewhat earlier. In Barbados, this seedling shows an undesirable tendency to root at the nodes of recumbent canes, but it is considered that this feature will not be so apparent in other islands where the spacing distances are invariably closer than in Barbados.

This seedling is recommended for trial throughout the thick cane areas.

B.3234.—This seedling appears to be adapted to the best growing conditions only. A long favourable growing season would appear to be necessary for it to produce a very high tonnage. Under conditions less favourable it would appear to give comparatively low tonnages. It is essentially a late-ripening seedling, and will be recommended for late reaped trials in areas with very good growing conditions.

Nothing definite can yet be said of the more recent seedlings—B.3259, B.3267, B.3307, B.3327 and B.3439. These will undergo further test in Barbados during the time they are undergoing quarantine at the Plant Quarantine Station.

References.

(1) McIntosh, A. E. S.—1933. Report on the Sugar Cane Breeding Problems of Antigua, Trinidad and St. Kitts. B.W.I. Central Sugar Cane Breeding Station, *Bull.* No. 1.

(2) McIntosh, A. E. S.—1934. Report on the Sugar Cane Variety Problems in St. Lucia. *Ibid. Bull.* No. 2.

(3) McIntosh, A. E. S.—1934. Report on a Visit to Jamaica. *Ibid. Bull.* No. 3.

(4) McIntosh, A. E. S.—1934. Report on a Visit to Grenada. *Ibid. Bull.* No. 4.

(5) McIntosh, A. E. S.—1935. Report on a Second Visit to Antigua. *Ibid. Bull.* No. 7.

(6) McIntosh, A. E. S.—1935. An Account of the Policy and Methods employed in the Breeding and Initial Stage of Selecting Sugar Cane Seedlings. *Ibid. Bull.* No. 6.

(7) McIntosh, A. E. S.—1935. An Account of the Methods employed in Testing and Selecting Sugar Cane Seedlings for Thick Cane Areas in the British West Indies. *Ibid. Bull.* No. 9.

MISCELLANEOUS NOTES.

***Control of Weevils in Stored Beans and Cowpeas**—*S. Marcovitch.*

In experiments in Tennessee various dusts were mixed in jars with beans from which adults of *Bruchus* (*Mylabris*) *obtectus*, Say, were about to emerge, and the jars were then kept at 65 to 90°F. for three months, during which period breeding entirely ceased or the beans became badly infested and finally decayed. The results show that beans may be protected by thorough mixture with hydrated lime at the rate of 1 lb. to one bushel seed or 1 : 65 ; those intended for seed only may be mixed with one ounce sodium fluosilicate to one bushel (1 : 1,000), or (as shown by other tests) stored in air-tight containers with 1 lb. flaked naphthalene or paradichlorobenzene to 50 cu. ft. space. Uninfested beans in closely woven sacks could be protected by a 1 inch layer of lime at the top. Damage was also prevented by the use of Anderson clay (1 : 75), copper carbonate (1 : 500) and sodium fluoride or barium fluosilicate (1 : 1,000). Sodium fluosilicate (1 : 1,500) was satisfactory against *Calandra* (*Sitophilus*) *granaria* L., and apparently against *Sitotroga cerealella*, Ol., in grain.—(*The Rev. of App. Ent.* A. Vol. XXIII, No. 2 pp. 69-70, 1935.)

* *Bull. Tenn. Agric. Exp. Sta.* No. 150, 8 pp., March 1934.

Wetting Agents in Insecticides and Fungicides.

The full effective action of insecticidal and fungicidal spray solutions is only obtained when the solution thoroughly wets the insect or fungal surface, and this is frequently secured by the addition of wetting agents or 'spreaders', a procedure which may involve difficulties where combined direct and protective washers are used. Evans and Martin (*J. Pom. Hort. Sci.*, 13, 4, 261) have made a survey of various wetting agents, the amount of spray retention on several standard surfaces being determined by the use of an apparatus designed to apply known amounts of spray solutions. Wetting properties are defined by the ability of the liquid to form a persistent liquid-solid interface when excess of liquid is drained from the surface, and the various physical properties examined, namely, spray retention, area of spread, contact angles and surface tension, all arrange the materials tested in the same general order of wetting activity. A classification is made of wetting agents on a structural basis, and it is suggested that the behaviour of materials of similar molecular structure may possibly be predicted by certain properties determined in the laboratory.—(*Nature*, Vol. CXXXVII, No. 3469, p. 710, 1936.)

THE BIRDS OF ST. KITTS AND NEVIS.

By Stuart T. Danforth, Ph.D.
University of Puerto Rico, Mayagüez, Puerto Rico.

Although birds have been known from St. Kitts and Nevis for many years, much less has been written concerning them than about those of most of the Lesser Antilles, and to my knowledge no previous attempt has been made to present a complete list of them. The islands have been somewhat neglected by itinerant ornithologists in their zeal to speed on to other islands with a richer avifauna and those who have been there have generally failed to give us any complete account of their finds.

In the Catalogue of Birds in the British Museum and other places we find mention of various specimens received in the early days from persons who were apparently resident in the islands, notably Messrs. W. Cottle and Henry Whitely of Nevis. Apparently the first ornithologist who visited St. Kitts was F. A. Ober, collecting for the Smithsonian Institution. He made a short stay in May, 1880, but got few birds (among them being the types of *Loxigilla grandis* and of *Cinclocerthia ruficauda pavida*), but no complete account of his collections was published.

There are some specimens in the Field Museum collected in St. Kitts by George Armstrong in January, 1888, about whom there seems to be no information on record.

In February and March, 1890, Cyrus S. Winch visited St. Kitts and made some extensive collections for C. B. Cory; these specimens are now in the Field Museum in Chicago. Cory published a nominal list of 24 species collected by him in the *Auk* for January, 1891 (pp. 47-49).

M. J. Nicoll, cruising on the "Valhalla", R.Y.S., stopped for three days (February 12 to 15, 1904), in St. Kitts. During this time he collected seven species, which are discussed, together with birds obtained on other islands, in the *Ibis* for October 1904, pp.555-591.

G. K. Noble, of the Museum of Comparative Zoology at Harvard University, collected a few birds in St. Kitts in June, 1904, but apparently no account of them has been published.

J. L. Peters, of the same institution, collected on St. Kitts in January, February and March, 1922, and also on Nevis in March, but likewise has published no account of his work.

James Bond, of the Academy of Natural Sciences of Philadelphia, collected on both islands in late December, 1928, and early January, 1929. Some of his records have been included in his "Birds of the West Indies", published in 1936, and he has kindly given me permission to publish other records which he has communicated to me in letters.

The present writer has made several short visits to both islands, on most of which observations were made, and on the two longest stays collections of birds, nests and eggs were made in addition. The visits on which observations were made are:—*St. Kitts*: 23rd to 24th July, 1922; 5th January, 1931; 1st to 12th August, 1931 (except for three days spent on Nevis); 25th July, 1933, and 20th to 29th June, 1935. *Nevis*: 5th to 8th August, 1931, and a few hours on 29th June, 1935; collections made both times. On the trips on which collections were made in both islands in 1931 and 1935 he was accompanied by Virgilio Biaggi, Jr., as assistant. Some new shorebird records obtained in 1931 were published in the *Auk* (1934, p. 103).

This paper is an account of observations and collections made on the writer's visits, together with the most important information gleaned from the writings of others for the sake of making as complete a list as possible.

The stomachs of most of the specimens collected were saved, and their contents examined in an effort to obtain information regarding the economic status of the birds. The results of these stomach analyses are here included.

It will be noted that there are now 63 species definitely known to occur or to have occurred in these islands; five others which have been recorded on doubtful evidence are here listed hypothetically, within brackets. Doubtless many additional species visit St. Kitts and Nevis at times as migrants, and the list of birds known from these islands could be considerably extended by the efforts of observers active during the fall and winter months. Species which are here recorded from these islands for the first time are indicated by an asterisk (*) in the annotated list which follows.

1. Pelecanus occidentalis occidentalis Linnaeus. Brown Pelican. Common around the coasts of both St. Kitts and Nevis, but probably breeds in neither.

***2. Sula leucogaster leucogaster** (Boddaert). Brown Booby. Three observed off the northwest coast of Nevis on 5th August, 1931.

***3. Fregata magnificens rothschildi** Mathews. Man-o'-war Bird. Scissor Tail. Single birds recorded at Basseterre, St. Kitts, 5th August, 1931, and at Charlestown, Nevis, 7th and 8th August, 1931.

4. Ardea herodias herodias Linnaeus. Great Blue Heron. One observed at Salt Pond, St. Kitts, 27th June, 1935. Bond, in a letter, lists the species from Nevis.

***5. Florida caerulea caerulescens** (Latham). Little Blue Heron. Gaulin. Bond, in a letter, informs me that he observed the species at Canada Pond, St. Kitts, 3rd January, 1929, and also on Nevis.

6. Butorides virescens maculatus (Boddaert). West Indian Green Heron. Little Gaulin. Sparingly distributed in both islands. The stomach of a male collected on Nevis 7th August, 1931 contained two small fishes.

[**Nycticorax nycticorax hoactli** (Gmelin). BLACK-CROWNED NIGHT HERON. Cooke (*U.S. Biological Survey Bulletin* 45, 1913, p. 60) lists this species from St. Kitts, citing Cory as authority. I have been unable to find any reference by Cory to this species, so it is listed here hypothetically.]

7. Nyctanassa violacea violacea (Linnaeus). YELLOW-CROWNED NIGHT HERON. NIGHT OR CRAB GAULIN. Winch obtained this species in St. Kitts in 1890, and on 22nd June, 1935, I observed an adult at Canada Pond, St. Kitts. Bond, in a letter, states he found a nest with three young at the same place 3rd January, 1929.

[**Dendrocygna arborea** (Linnaeus . WEST INDIAN TREE DUCK. WHISTLER. Bond (*Birds of the West Indies*, 1936, p. 39) states that this species probably occurs casually on St. Kitts. There is no definite record.]

8. Dafila bahamensis bahamensis (Linnaeus). BAHAMA DUCK. WHITE-THROAT. A pair was seen on a small lagoon near Salt Pond, St. Kitts, on 27th June, 1935.

9. Oxyura jamaicensis jamaicensis (Gmelin). WEST INDIAN RUDDY DUCK. Bond (*Birds of the West Indies*, 1936, p. 43) lists this duck from St. Kitts.

10. Buteo borealis jamaicensis (Gmelin). WEST INDIAN RED-TAILED HAWK. CHICKEN HAWK. Cory lists this hawk from St. Kitts, and Bond from Nevis in addition. I observed a few in the vicinity of Canada Hill and Frigate Bay, St. Kitts, in June 1935. Two hawks observed over the dense forest on the Crater 23rd June, 1935, appeared to be *Buteo platypterus*, but as it was impossible to observe them closely enough to make a positive identification, the latter species is not listed. Results of stomach analyses of Red-tailed Hawks in other places prove that, despite public belief to the contrary, it is a highly beneficial species due to the destruction of rats and other small mammals. The damage done by consuming an occasional chicken is much more than offset by the benefits received by the destruction of rats.

11. Falco peregrinus anatum Bonaparte. DUCK HAWK. Sharpe (*British Museum Catalogue*, I, 1874, p. 376) lists a juvenile male from Nevis in the British Museum, presented by W. Cottle. Migratory.

12. Falco columbarius columbarius Linnaeus. PIGEON HAWK. This migratory hawk is listed by Bond from St. Kitts and Nevis, and by Cory from the former.

13. Falco sparverius caribaearum Gmelin. ANTILLEAN SPARROW HAWK. KILLI-KILLI. A well known, but at present only tolerably common, resident of both islands. On St. Kitts it was observed at Belmont, Monkey Hill, Basseterre and Salt Pond. A pair was collected at Salt Pond 27th June, 1935. One stomach contained a large cutworm and many small beetles; the other an *Anolis* lizard and a grasshopper. Three were seen near Charlestown, Nevis on 7th August, 1932.

14. Colinus virginianus virginianus (Linnaeus). QUAIL. Introduced on St. Kitts many years ago, but now extirpated by the mongoose.

15. Porzana carolina (Linnaeus). SORA RAIL. This migratory species is listed from St. Kitts by Bond.

* **16. Gallinula chloropus portoricensis** Danforth. ANTILLEAN GALLINULE. RED-SEAL COOT. Bond (in a letter) states that he found it common at Canada Pond, St. Kitts in 1929, where on 3rd January he found several nests with eggs, one of which contained what appeared to be a Ruddy Duck's egg along with those of the Gallinule. At the time of my visits the pond was dry, so no gallinules were present.

17. Fulica caribaea Ridgway. CARIBBEAN COOT. WHITE-SEAL COOT. Listed by Bond from St. Kitts. In a letter he says he collected a single egg at Canada Pond on 3rd January, 1929.

* **18. Squatarola squatarola cynosurae** Thayer and Bangs. BLACK-BELLIED PLOVER. Five were noted at Frigate Bay Lagoon, St. Kitts on 25th June, 1935.

19. Pagolla wilsonia rufinucha (Ridgway). RUFOUS-NAPED PLOVER. Common and apparently resident on St. Kitts, where many individuals were noted at Canada Pond, Frigate Bay Lagoon, and Salt Pond in June 1935, and at Canada Pond in August 1931. A female was collected at each locality in 1935. Curiously, no black-collared males were noted. The three stomachs contained small crabs 63 per cent.; Carabid beetles 14 per cent.; other beetles 6 per cent., and Carabid larvae 17 per cent.

20. Arenaria interpres morinella (Linnaeus). RUDDY TURNSTONE. On St. Kitts ten were observed at Canada Pond on 10th August, 1931; ten (including a male collected) at Frigate Bay Lagoon on 25th June, 1935, and one at Salt Pond 27th June, 1935. The stomach of the bird collected contained three Stratiomyid larvae, *Persicaria* seeds and some gravel. Two were observed on Nevis 7th August, 1931.

21. Capella delicata (Ord). WILSON'S SNIPE. Listed from St. Kitts by Bond.

22. Actitis macularia (Linnaeus). SPOTTED SANDPIPER. Common migrant, observed on both islands in August, 1931.

23. Tringa flavipes (Gmelin). LESSER YELLOWLEGS. Winch obtained specimens on St. Kitts in 1890, and I observed one at Canada Pond 10th August, 1931.

* **24. Tringa melanoleuca** (Gmelin). GREATER YELLOWLEGS. One observed at Salt Pond, St. Kitts, 27th June, 1935.

25. Ereunetes pusillus (Linnaeus). SEMIPALMATED SANDPIPER. Five observed at Canada Pond, St. Kitts, 10th August, 1931, and one of two observed was collected at Frigate Bay Lagoon 25th June, 1935; its stomach contained 175 small dipterous larvae, some *Persicaria* seeds, and sand.

26. Erolia minutilla (Vieillot). LEAST SANDPIPER. Nicoll (*Ibis*, 1904, p. 574) records one shot at St. Kitts in February, 1904. I observed four near Charlestown, Nevis, on 7th August, 1931.

27. Himantopus himantopus mexicanus (Müller). BLACK-NECKED STILT. Local names Allemore and Pond Crane. Fairly common on St. Kitts, where seen at Frigate Bay Lagoon, Salt Pond, and Canada Pond 22nd to 27th June, 1935, and at the latter locality on 10th August, 1931. It probably breeds, as a male taken at Canada Pond, 22nd June, was in breeding condition; it had eaten seven mole crickets (*Scapteriscus vicinus*), two weevils (*Sphenophorus venustus*), and three caterpillars.

28. Larus atricilla (Linnaeus). LAUGHING GULL. Common along the coasts of both islands in summer.

29. Sterna dougallii dougallii Montagu. ROSEATE TERN. Observed in St. Kitts at Basseterre on 12th August, 1931, and 25th July, 1933; and at Friar's Bay and Salt Pond 25th June, 1935. On Nevis it was seen 1st, 5th and 7th August, 1931, and 29th June, 1935. A female collected there 7th August, 1931, had eaten three sardine-like fishes, 4, 3 and 2½ inches in length.

30. Sterna albifrons antillarum (Lesson). LEAST TERN. Common summer resident on St. Kitts, where observed in many places; ten noted 5th August, 1931 on the coast of Nevis. On 25th June, 1935 a breeding colony of about 30 pairs was located, nesting on the dried up bottom of Canada Pond. A pair of breeding adults was collected. Several young in various stages of development were captured alive, two of which were preserved as alcoholics. The eggs were laid on the bare mudflats where dry and quite firm, and this time were coated with mud which had stuck to them and dried on them. A set of two slightly incubated eggs collected measured 32.2 × 23.4 and 32.0 × 23.6 millimeters. The stomach of one adult contained small fishes, the other was empty.

***31. Sterna fuscata fuscata** Linnaeus. SOOTY TERN. One observed off the southern end of St. Kitts 5th August, 1931; and 20 flying about wildly in Basseterre Harbour during a hurricane on 25th July, 1933.

32. Thalasseus maximus maximus (Boddaert). ROYAL TERN. Recorded from both islands in winter.

***33. Anoüs stolidus stolidus** (Linnaeus). NODDY TERN. Ten observed on the coast at Friar's Bay, St. Kitts, 25th June, 1935; and off the northwest coast of Nevis 50 were seen 5th August, and 25 on 8th August, 1931.

***34. Columba squamosa** Bonnaterre. SCALED PIGEON. RED-HEAD PIGEON. On St. Kitts ten were observed in the cloud forest on the Crater 23rd June, 1935, and one on the hill at Frigate Bay 25th June, 1335.

35. Zenaida aurita aurita (Temminck). ZENAIDA DOVE. MOUNTAIN DOVE. Common resident on both islands. The stomach of a male collected on Monkey Hill, St. Kitts, 21st June, 1935, contained pulverized black fruit and gravel. A set of two eggs on the point of hatching collected near Charlestown, Nevis, on 29th June, 1935, measure 30.5 × 23.7 and 30.5 × 23.1 millimeters.

36. Columbigallina passerina nigrirostris Danforth. ST. KITTS GROUND DOVE. This form, which I have recently (*Journ. Agric. Univ. of P.R.*, 19, 1935, p. 483) described from St. Kitts, differs from the Ground Dove of Puerto Rico and the Virgin Islands principally by reason of its dusky bill. It is a common resident on both St. Kitts and Nevis. Three stomachs from St. Kitts and two from Nevis contained exclusively seeds, mainly some sunflower-like Composite seeds. Smaller numbers of grass, *Persicaria*, and other seeds were found, and one stomach from St. Kitts contained exclusively seeds of *Sida* sp. (Malvaceae). On 25th June, 1935, at Friar's Bay, St. Kitts, a set of two fresh eggs was collected from a flimsy nest on fine twigs placed nine feet from the ground on a small branch of a spiny leguminous tree; the eggs measure 20.8 × 16.1 and 21.8 × 16.1 millimeters. On 29th June, 1935, at Charlestown, Nevis, two sets of eggs were collected, and two nestlings were preserved as alcoholics. Two of the eggs were broken in transit to Puerto Rico; the other two (from different sets) measure 21.6 × 16.4 and 21.9 × 15.0 millimeters.

37. Oreopeleia mystacea mystacea (Temminck). BRIDLED QUAIL DOVE. PARTRIDGE. The only published records of this bird from St. Kitts and Nevis are those of Bond (*Birds of the West Indies*, p. 159). Dr. J. G. Myers informs me that late in 1934 he obtained the head and some feathers of one which had been shot for the table by Mr. Philip Todd (which are now in the possession of Mr. G. D. Smooker of Trinidad), and a few days later he flushed a living specimen on the western slopes of Mt. Misery. On 9th August, 1931 I noted three on Olivees Mt., and on our ascent of the Crater 23rd June, 1935, we heard six calling, and Biaggi collected a male. Its stomach contained two fruits of *Chrysobalanus*. One was noted on the mountain on Nevis, 5th August, 1931.

[***Oreopeleia martinica** (Linnaeus). MARTINIQUE QUAIL DOVE. I feel very sure that I saw one and heard another on Nevis Mountain 6th August, 1931, but as the species has not been collected in this region I am listing it hypothetically.]

[***Coccyzus** sp. On 27th June, 1935, a cuckoo of some species was heard calling near Salt Pond, St. Kitts. No birds of this family have been recorded in this region.]

***38. Chaetura martinica** (Hermann). LESSER ANTILLEAN SWIFT. One was observed in the lower part of the mountain forest at Jessup's, Nevis, on 5th August, 1931.

39. Eulampis jugularis (Linnaeus). GARNET-THROATED HUMMING BIRD. Cory states there are 10 specimens from St. Kitts in the Field Museum. Berlepsch (*Ibis*, 1887, p. 294) described *E. j. eximius* from Nevis on the basis of two specimens received from Henry Whitely. I saw none on either island, but Mr. Harold E. Box informs me he obtained one on St. Kitts recently, captured in an insect net.

40. Sericotes holosericeus holosericeus (Linnaeus). BLUE-BREASTED HUMMING BIRD. Common in both islands. It feeds on the nectar of flowers and small insects; the stomach of one of the two specimens collected on St. Kitts also had two small spider egg cases.

41. Orthorhynchos exilis exilis (Gmelin). CRESTED HUMMING BIRD. The smallest and commonest of the humming birds in both islands. Two collected on St. Kitts.

42. Megaceryle alcyon alcyon (Linnaeus). BELTED KINGFISHER. Known as a winter migrant to both islands.

[**Megaceryle torquata stictipennis** (Lawrence). RINGED KINGFISHER. Of very doubtful occurrence on St. Kitts (cf. Bond, *Birds of the West Indies*, 1936, p. 225).]

43. Tyrannus dominicensis vorax Vieillot. LARGE-BILLED KINGBIRD. CHI-CHI BIRD. PIPIRI. Abundant resident on both islands. On 28th June, 1935, a nest with three fledglings nearly ready to fly was collected on Canada Hill, St. Kitts; two were skinned, and the third was preserved as an alcoholic. The nest was a rather bulky and loosely made structure of small twigs, lined with fine roots. The stomachs of six adults from St. Kitts contained 87 per cent. of arthropods, mainly insects, and 13 per cent. of lizards. Hymenoptera constituted 30 per cent. (including Andrenid bees 4 per cent.; Halictid bees 4.3 per cent.; Sphecid wasps, *Stictia signata*, 7.5 per cent.; Larrid wasps 2.5 per cent.; Vespid wasps, *Polistes* sp., 11.7 per cent.); Coleoptera formed 31.7 per cent. (including 28.4 per cent. of Sugar Cane Stalk Borers, *Metamasius hemipterus*, eight of these were found in one stomach, three in another and one in a third). Long-legged web-building spiders formed 15 per cent. of the total food, and Sphingid caterpillars 10.3 per cent. One stomach from Nevis contained three Larrid wasps. Although this species does some damage by the consumption of lizards and beneficial Hymenoptera, the presence of so large a proportion of *Metamasius* in its food indicates the desirability of attracting it to cane plantations.

44. Myiarchus oberi berlepschii Cory. St. Kitts Flycatcher. Mountain Loggerhead. Locally common in the mountain forests on St. Kitts, and Bond obtained it on Nevis. I found it common in certain spots on the Crater, St. Kitts, 23rd June, 1935, and obtained three specimens. They had two distinct notes, a high pitched whistling sound somewhat suggestive of the whistling of a dove's wings in flight, and also a *wheee* somewhat like that of *M. antillarum* of Puerto Rico, but shorter and not quite so loud. The three stomachs contained drupes 13 per cent., and insects 87 per cent., including earwigs, small beetles, and a Coreid bug.

45. Elaenia martinica martinica (Linnaeus). Caribbean Elaenia. Whistling Bird. John Phillip. Common on both islands. This bird, unlike most flycatchers, is almost exclusively vegetarian in its diet. Four stomachs from St. Kitts and one from Nevis contained nothing but drupes and berries.

46. Progne dominicensis (Gmelin). Caribbean Martin. Swallow. Fairly common in St. Kitts, where Winch obtained it in 1890. I observed it at Basseterre 20th, 21st and 29th June, 1935, Olivees Mountain 9th August, 1931, Brimstone Hill 10th August, 1931, and Frigate Bay 25th June, 1935.

***47. Hirundo erythrogaster** Boddaert. Barn Swallow. Bond (in a letter) informs me he observed a number of this migratory species near Canada Pond, St. Kitts, 3rd January, 1929, and that he also saw it on Nevis.

48. Mimus gilvus antillarum Hellmayr and Seilern. Grenada Mockingbird. Introduced on Nevis many years ago, but now extirpated.

49. Allenia fusca (Müller). Scaly-breasted Thrasher. Black-billed Thrush. Not very common; found in wooded regions on both islands. Two specimens were collected on St. Kitts, where it was observed on Olivees Mt., Monkey Hill, and the Crater. One stomach had parts of a soursop fruit and many tender leaves of the same tree. One was seen at Jessup's, Nevis.

50. Margarops fuscatus fuscatus (Vieillot). Pearly-eyed Thrasher. Wall-eyed Thrush. On St. Kitts abundant in the high forest on the Crater, and observed at Monkey Hill and Olivees Mountain. On Nevis it was the only bird that could be said to be common in the mountain forest.

51. Cinclocerthia ruficauda pavida Ridgway. Trembler. Bond found it on Mt. Misery, in St. Kitts, but I failed to find it there. Recorded from Nevis, but perhaps extinct on that island.

52. Vireo calidris barbadensis Ridgway. Barbados Vireo. John-to-whit; Chi-chi-wink. Common in summer in both islands; not previously recorded from Nevis. At Basseterre, St. Kitts on 28th June, 1935 a nest with three slightly incubated eggs was obtained. It was placed in the fork of a small branch of a West Indian Cedar tree, and was a typical vireonine pensile structure, made of grasses and other plant fibres, mixed with vegetable wool, and lined with fine grasses. The eggs were of variable form, some being rather sharply pointed; white, with large dark brownish red spots, especially at the larger end; they measured 19×15.5, 19.3×15.5 and 21.4×15.4 millimeters. Four stomachs from St. Kitts had 32.5 per cent. of vegetable matter (11 purplish drupes and seeds of small fruits), and 67.5 per cent. of animal matter (spiders 11.25 per cent.; caterpillars 25 per cent.; Hemiptera 28.75 per cent.; a moth 1.25 per cent.; and a beetle 1.25 per cent).

53. Coereba bartholemica (Sparrmann). St. Kitts Honey Creeper. Yellow-breast. Common on both islands. A nest with three young, with eyes about to open, was obtained on Canada Hill, St. Kitts 28th June, 1935. The nest was the usual dome-shaped structure, made of grasses and other plant fibres, with some feathers of barnyard fowl interspersed. The young were preserved as alcoholics. Five stomachs from St. Kitts had 10 per cent. of small black seeds, 20 per cent. of fruit fibres, and 70 per cent. of insects (including 39.4 per cent. of caterpillars and 29 per cent. of beetles). One stomach from Nevis had two small seeds.

54. Mniotilta varia (Linnaeus). Black and White Warbler. Migrant; there is a specimen from St. Kitts in the Field Museum, and Bond records the species from Nevis.

55. Compsothlypis americana pusilla (Wilson). Northern Parula Warbler. Migrant; Winch obtained four specimens in St. Kitts in 1890, and Nicoll reported it very numerous there in February, 1904. It is also recorded by Bond.

56. Dendroica petechia bartholemica Sundevall. Golden Warbler. Wild Canary. Common on both islands in mangroves, arid scrub, and second growth woods. At Canada Pond, St. Kitts, 28th June, 1935, a nest with two young (eyes just opening) and one addled egg was obtained. The nest was made of dried grasses, lined with vegetable wool, a few feathers and a spider's egg case. The young were preserved as alcoholics; the egg is white with dull lilac and reddish spots forming a dense wreath around the larger end; it measures 16.3×13.1 millimeters. Four stomachs from St. Kitts contained exclusively insects and their larvae. Caterpillars formed 50 per cent.; Coleoptera (including Chrysomelidae) 20 per cent.; Muscid flies 11.2 per cent.; Hemiptera 1.2 per cent.; and the rest were unidentifiable. One stomach from Nevis contained Coleoptera and other insects.

57. Dendroica discolor discolor (Vieillot). Prairie Warbler. There are three specimens from St. Kitts in the Field Museum, and Bond records it from Nevis. Migrant.

58. Seiurus motacilla (Vieillot). Louisiana Water-thrush. Migrant. Hellmayr lists a specimen from St. Kitts in the Field Museum.

59. Setophaga ruticilla (Linnaeus). American Redstart. Migrant; occurs in both islands. There are 14 specimens from St. Kitts in the Field Museum.

60. Holoquiscalus sp. Grackle. Grackles of some species were introduced in St. Kitts approximately ten years ago; I was unable to ascertain from where they were brought. I observed one near Basseterre on 5th January, 1931, but have seen none on subsequent visits.

61. Tiaris bicolor omissa Jardine. Carib Grass-quit. Probably the most abundant bird on both islands. Six stomachs from St. Kitts and one from Nevis contained nothing but small seeds and sand.

62. Loxigilla grandis Lawrence. St. Kitts Bullfinch. Mountain Blacksmith. This bird, peculiar to St. Kitts, was formerly found in the mountain forests, where Ober obtained nine in 1880, but it is probably now extinct, as it has not been seen for many years.

63. Loxigilla noctis coryi (Ridgway). Lesser Antillean Bullfinch. Sparrow; Black Bird (male); Brown Bird (female). Common and tame

on both islands. Many nests were found on St. Kitts in the latter part of June, 1935; they were domed structures of coarse grasses, in one case mixed with considerable cotton, and lined with finer plant fibres, in some cases with the addition of a little cotton or a few feathers. They were placed at heights of 4 to 9 feet in small trees, usually spiny leguminous ones; a few were in the mangroves. They contained from one to three eggs, white, more or less thickly speckled with reddish, especially at the larger end. One set of three measured 17.3×13.0, 17.7×13.0, and 16.8×12.9 millimeters. A single egg measured 17.2×12.3 millimeters. Others seen were not collected. Three new-hatched young in one nest were preserved as alcoholics. A set of two eggs was collected on Nevis 29th June, 1935, which were unfortunately broken in transit before they could be measured. Nine stomachs from St. Kitts contained 52.2 per cent. of vegetable matter (fruits and seeds) and 48.8 per cent. of animal matter (22.2 per cent. of caterpillars and 26.6 per cent. of Coleoptera and their larvae). Two stomachs from Nevis contained 6.5 per cent. of fruits and seeds and 93.5 per cent. of insects, mainly Coleoptera, although one moth was recognized. The Coleoptera were mostly weevils.

COCOA : WORLD CONSUMPTION.

The available statistics for 1935 are now sufficiently complete to give a picture of the general trend of consumption; it is quite apparent that the increase in consumption already noted in those better-known countries, where large quantities are imported and used, is in fact more or less general throughout all countries large and small, where Cocoa products are in demand. The outstanding exception is Germany, where Government regulations and control of import and manufacture exist.

In countries where import duty and bonded stores exist it is possible to get a very reliable gauge of actual consumption, as it may be safely assumed that manufacturers who are allowed to retain Cocoa " in bond " are unlikely to pay duty until actually in the position of being about to use the Cocoa. Figures have been available to show that in the year 1935 United Kingdom consumption increased by 13.9 per cent. over 1934, and that, going further back, the increase was 46.4 per cent. compared with ten years ago, viz.: the year 1925. In France the increase in 1935 over 1934 was 7.9 per cent., but ten years ago it was practically the same, 1935 showing an increase over 1925 of only about one per cent. In U.S.A. the basis of " duty paid " calculations is not practicable, but reliable figures are furnished from time to time of " deliveries into consumption ", which, if not representing actual consumption, bear a very close relationship to it. In the year 1935 there was a heavy increase over 1934, viz.: 21.9 per cent., and comparing 1935 with 1925 there is shown an increase even larger than in the United Kingdom for the same period, namely 53.8 per cent., a prodigious advance.

In other countries, large and small, comparisons, can only be made in the absence of more reliable material, upon imports, but it may be safely assumed that in a general way, imports are controlled by the extent of consumption and, over a reasonably long period, bear close relationship to actual absorption by manufacturers. The available records of imports show that the 22 countries furnishing such statistics show an increase in imports in 1935 of nearly 90,000 tons or an average increase of 16.7 per cent. over 1934. This is after making allowance for the heavy reduction of imports into Germany for 1935, namely 26,642 tons, or 26.2 per cent.; it is patent that the other 21 countries must have shared increased imports on a substantial scale to enable such a large average increase of 16.7 per cent. to be achieved. Actually, out of the 22 countries for which import records are available, 19 show increases and only three countries (including Germany) show a decline. The other two countries registering declines are the Irish Free State and Australia; it is likely in the latter case that it is a question of overlapping of figures. The total imports of Australia from January to November were 6,290 tons in 1935, as compared with 6,728 tons in 1934. Imports into Irish Free State are so small as to be unimportant, so that only leaves Germany with a significant reduction after her record heavy year in 1934.

The increases, on the other hand, are varied and general. Russia leads the field with increased imports which may be roundly expressed as three times more in 1935 than in 1934. Reverting to percentages, the highest figures applies to imports into Italy, which shows 58 per cent. increase. Hungary comes next with an increase of 47 per cent., then Czechoslovakia with just over 28 per cent., and Sweden with just under 28 per cent. increase. Denmark increased imports by 20 per cent., and Holland by 16 per cent. Switzerland registered an increase of over six per cent., Belgium and Austria 5½ per cent., and small increases are registered for Spain, Norway, Poland and Finland.

Turning away from Europe, we find a big increase in New Zealand, namely 26 per cent., and in Canada an increase of 24 per cent. in 1935, as compared with 1934.

Whilst some of these increases, apparently big when given in terms of percentage, represent only modest tonnage, the consistent general increase must clearly signify that from whatever cause, there is not only a more widespread consumption of Cocoa products, but that the trade is constantly expanding, even in spite of wide variations in national tastes, climate and habits.—(*Monthly Report of the Cocoa Association of London Ltd.*, No. 66, p. 3, 1936.)

CAULIFLOWER CULTIVATION IN THE TROPICS.

By R. Cecil Wood and H. M. James.

The successful cultivation of cauliflowers in the West Indies does not merely imply the addition of a new and palatable vegetable to a Tropical diet. From the experience gained at the College Farm during the past year, it seems likely that they could be produced on a considerable scale for export purposes. The crop is not a difficult one to grow, though it requires careful treatment; it possesses a high value and seems to stand cold storage well. It would be a suitable crop for peasant cultivation, if marketing facilities could be arranged.

The success of this crop has only recently been made possible by the use of Indian-grown strains from that famous house of seedmen, Messrs. Sutton & Sons, under the name of 'Patna' and 'Benares' strains. The strain used in the present case was that known as 'Early Patna'. The origin of these strains, as kindly explained in a letter from the firm, is uncertain, but it seems likely that the Patna strain was a selection from their well-known 'Improved Snowball', acclimatised and selected for some years in India. Other Sutton's strains which are reported to be satisfactory are 'Main Crop Patna' and 'Early and Main Crop Benares' in British Guiana (1) and 'Early Market' in Barbados*. No other strains have, as far as the writers are aware, been successful in the Tropics (2).

Season.

The seasonal limits of this crop have not yet been defined. On the College Farm this season, cultivation started with the sowing of the first seedbed on 10th September, and seedlings from this sowing were planted out on 30th September. Planting was more or less continuous from then until 1st February when the last portion of Field 6 was planted. The table below gives some relevant metorological figures.

TABLE I.

Average of Seven Years.

Month.	Rainfall.	Temperature.		Av. Min. Humidity.	Av. Hrs. Sunshine.
		Av. Max.	Av. Min.		
October ..	7.38	87.0	71.7	63.0	6.86
November ..	7.34	83.1	71.1	65.2	6.66
December ..	5.97	84.3	69.6	62.6	6.99
January ..	2.62	83.7	67.1	57.7	7.23
February ..	1.05	84.0	66.3	53.1	8.05
March ..	1.52	85.7	67.6	51.8	8.20
April ..	1.43	87.0	70.5	52.4	8.50

* Private communication from the Director of Agriculture, Barbados.

It is apparent that without facilities for irrigation, it would not have been possible to plant out much later than 1st January. Even with irrigation, it is likely that the temperatures in late April and May are too great for the crop, though early showers towards the end of May might cool the land down sufficiently to get a crop through before the heavy rains of July. A long close season however, is desirable in order to cope with the insect pests that attack the crop.

Sowing.

The seed, which is small, is sown out in beds or boxes in which it remains for about ten days, by which time the young seedlings are ready for pricking out into three feet beds, where they are spaced about four inches by four inches. Here they remain for a further three weeks, when they should be about six inches in height. It has been found that light shade is beneficial to the young seedlings, and, by encouraging quicker growth, saves time in the nursery. The seedlings will not all be ready together, but after about four to five weeks from the original sowing, some should be ready for planting out in the field (Fig. 1). The spacing adopted here is two feet by two feet. There is no peculiarity in the planting, though there is perhaps a tendency to plant the seedlings too deeply. Supplying will always be necessary and is often heavy.

Manure.

As for all vegetables, the land should be in good heart and the crop will take any quantity of organic manure. It will be noticed that an excellent yield was obtained from Field 13B, which was an odd corner on which had been stacked a large pile of pigeon pea (*Cajanus*) stalks for some months previously. Under this heap had accumulated a quantity of organic matter in the shape of fallen leaves, buds and broken twigs. Good results should be obtained from a dressing of 20 tons per acre of good Pen Manure, along with two cwt. Blood Meal one cwt. S/A, and adequate supplies of Potash and Phosphoric Acid.

There is little to say about the subsequent cultivation of the crop. Weeding will be necessary, but it should not be long before the plants begin to close over (Fig. 2) and then the main business will be to deal with the insects that attack the crop, of which the worst is *Hellula phidilealis*. This pest was studied by one of us, and a note on its life-history and the measures found successful in dealing with it, are given below. It must be emphasised that unless this pest can be controlled, *the cultivation may be a complete failure.*

As the flowers begin to form, it may be worth while to skewer three or four leaves together to shade the flowers, in order to preserve the white colour which is desired. The operation is simple, and the thin midrib of the coconut leaflet, such

CAULIFLOWER CULTIVATION IN THE TROPICS.

FIG. 1.—*Showing seedlings and method of transplanting.*

FIG. 2.—*Full grown field, ripe heads being collected.*

CAULIFLOWER CULTIVATION IN THE TROPICS.

FIG. 3.—*A typical group of 'Early Patna' Cauliflowers averaging about 1½ lb. apiece.*

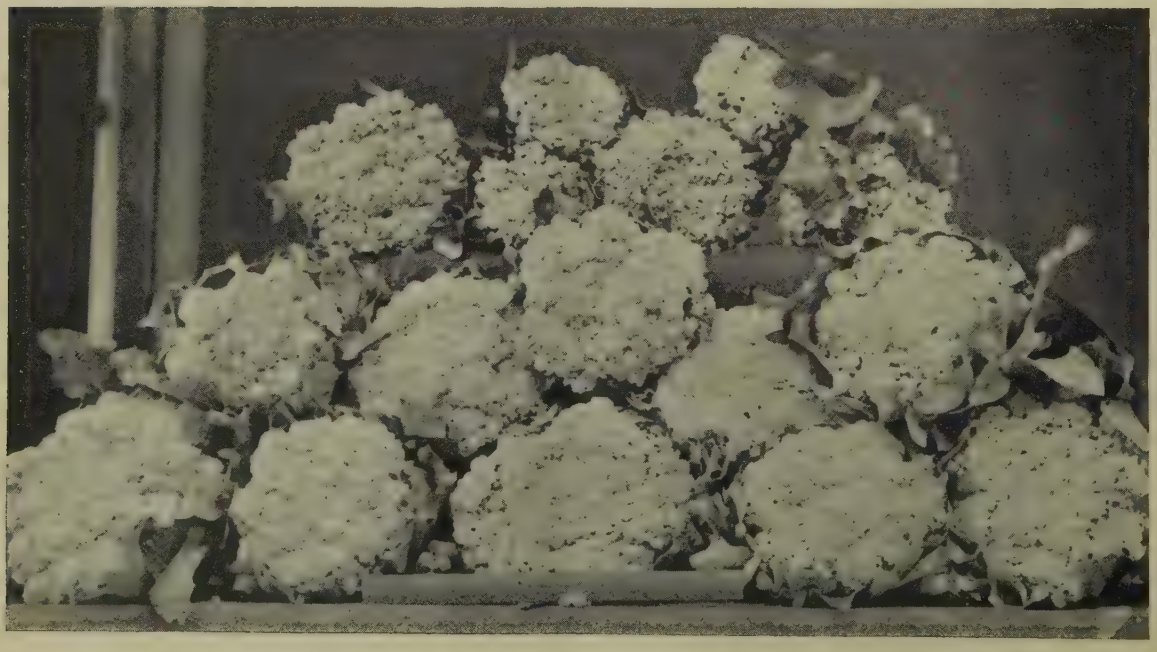

FIG. 4.—*Showing contrast between properly developed heads along the lower row and deformed and ricey heads in upper row.*

as is used to make brooms, is found quite efficacious. It will be seen that the plants form heads very irregularly, and while a few will be found seven or eight weeks from sowing, the heads formed so early are very small and hardly marketable. Good cauliflowers will begin to appear from nine to 12 weeks from sowing (three to six weeks after planting out), and will be ready for cutting at 13 to 16 weeks of age (Fig. 3).

Heads should, if possible, be cut the day they ripen, for faults soon appear if harvesting is delayed. Over-mature heads tend to separate and become loose. A slight elongation of the ultimate branches causes the condition known as 'riciness' (3), and such heads, though they may not suffer in taste, are objectionable in appearance. With the advent of drier conditions, a certain number of deformities will be found; heads become small, and are often fuzzy in appearance, owing to the elongation of the individual flower-stems. Small-sized heads may also result from planting over-mature seedlings from the seed-beds (Fig. 4).

The average weight of heads will be seen in the table below, and is a pound or a little over. Some very fine specimens weighed as much as 4 lb., in a closely-trimmed condition.

Cauliflowers are sold by weight, and it is understood that the outer leaves must be removed and the inner leaves trimmed level with the surface of the flower. When heads are to be sent to cold storage, it is found better not to cut the leaves, but bend them over the heads, in order to reduce desiccation.

Economics.

In the table below are set out the yields of the four plots in which this crop was grown in the past season on the College Farm.

TABLE II.

	Area acres.	No. of seedlings planted out.	Heads harvested.	Percentage.	No. of heads per acre.	Wt. per acre lb.	Av. wt. per head lb.
F. 6	.62	6,534	2,125	35	3,427	3,598	1.0
F. 13B	.04	540	291	54	7,275	8,175	1.1
F. 16A	.06	700	419	60	6,980	9,330	1.3
F. 34	.25	2,722	301	11	1,204	1,147	.9

Fields 13B and 16A were both planted early (October) and enjoyed good growing weather although they were probably the worst attacked by the *Hellula* caterpillar. Field 6 was on a larger scale, and was planted in January; the weather became dry as the crop matured, and it had to be irrigated. Field 34 was further away from the steading, and was on a plot which was found to be of much less fertility than had been thought. It did not receive so much attention, suffered severely from cut-worms, and was at one time almost abandoned.

The yields given above are the yields of saleable heads, and the crop was sold at a price of 20 cents per lb. retail, and 16 cents wholesale. At this price, there has been no difficulty in disposing of the whole crop of over 3,000 cauliflowers in the season from December to April.

Reference has been made to the storage of a portion of the crop for experimental purposes, and the first results obtained were recorded in *Tropical Agriculture*, XI, 199. Subsequent experiments indicate that desiccation can be largely prevented by folding uncut leaves over the flower, and that there would be no difficulty in holding cauliflowers for sale for periods up to 40 days.

Insect Pests.

Soon after planting it was noticed that the young plants were being severely attacked by a small caterpillar which ate into the central bud, and caused severe distortion, frequently resulting in death. A careful study of the life-history of this caterpillar was made, as it was evident that unless it could be controlled, there was little prospect of success. It was difficult to identify, and it was only after a number of young plants had been transplanted into pots and kept in cages, that the moth was observed and identified as *Hellula phidilealis* (4).

The life-history of this pest is as follows. Eggs are deposited on any portion of the leaf, but mainly on those portions facing uppermost. They are very difficult to see, being small ($\frac{1}{50}$ to $\frac{1}{25}$ of an inch in length) and of a greyish colour when first laid, changing to a reddish-brown just before hatching. The egg-stage lasts four to six days. The larvae start eating the leaf-tissue at once and are completely inside the leaf within two hours of hatching. They remain inside the leaf for about four days, sometimes longer (*i.e.* until they are about $\frac{1}{4}$-inch in length), and then move down the stem and begin to attack the bud. They are soon inside the bud and cover themselves with a web, their presence being easily noticed by the large amount of frass deposited outside the tunnel. The larvae possess a characteristic brown pattern on the back of their bright yellow bodies. After 15 days in the bud, during which time the larvae grow to about $\frac{3}{4}$-inch long, they emerge from the same hole by which they entered, move down the stem and, a few inches away from the plant, go into the soil where they bury themselves and begin to pupate. The larva forms a small, smooth-walled chamber for itself and is transformed into a pupa that is about $\frac{1}{4}$-inch long, and brown in colour. The adult moth emerges in 11 days and is small and silvery-coloured, having a wing-spread from tip to tip of about $\frac{1}{2}$-inch, and a body length of not more than $\frac{1}{4}$-inch.

Life History:—

Egg stage.—4 to 6 days.
Larval stage.—19 to 20 days.
Pupal stage.—10 to 11 days.

The pest has been noted before and is reported to feed only on Cruciferous plants. From the heavy infection which appeared on the first-planted seedlings, it was evident that the pest was about in large numbers, but search failed to reveal any Cruciferous weeds, nor was the pest found on the Capparidaceous weeds which were plentiful in the neighbourhood. Attention at this stage was called to the cultivation of *Brassica sinensis*, the Chinese Cabbage or 'Patchoi', which was commonly cultivated in the vicinity and on which the pest was found in large numbers. It is as well to emphasise that no other *Cruciferae*, such as Cabbage or Radish, should be grown, and that there should always be a fairly long close season before the start of the cauliflower crop.

Opportunity for dealing with the pest seemed slight, owing to the brief time that it is vulnerable, —from the time when it crawls down the leaf where the egg is laid, to the bud; the period being two or three hours before it is hidden and protected by a web. Hand-picking was at first resorted to, but this was laborious. The use of a spray was recorded in the Philippines (2), and a mixture of five spoonfuls of lead arsenate in a kerosene tin (four gallons) of water was found to be effective. Dusting with Paris green and lime in the ratio of 1 : 16 has been found more efficient, for spraying is difficult on account of the habit of the plant, and the waxiness of the leaves, which necessitates the addition of an efficient sticker. Also, to be effective, spraying must be done at least twice a week, while in the dry weather the dust remains effective for a much longer period. It is of course obvious that the use of poison must be discontinued before the heads begin to form.

Continuous hoeing results in the destruction of large numbers of pupae in the soil. Affected plants should be removed at once and destroyed, and the site of the plant should be hoed. The attack is naturally more severe when the plants are young; in older plants the caterpillar seems to bore into the bases of the larger leaves rather than into the bud.

Summary.

1. An account is given of trial plantings of 'Early Patna' Cauliflowers and the results obtained.

2. The life-history of a serious pest—*Hellula phidilealis*—is described, and the remedial measures taken against it.

3. The possibilities of the crop for export purposes are discussed.

References.

1. Anon.—Hints on vegetable culture. *The Agl. Jl. of British Guiana*, VI, 134.
2. Rodrigo *et al.*—A Progress Report on the acclimatization of Cauliflowers, 1933-34. *Philippine Jl. of Agric.*, VI, 115.
3. Jones, H. A. and Ernst, F. H.—Cauliflower production in California. *Calif. Agr. Extension Service, Circular* 1.
4. Kaye, W. J. and Lamont, N.—A Catalogue of the Trinidad Lepidoptera Heterocera (Moths). *Dept. Agric. Trinidad and Tobago, Mem.* 3, 1927.

REVIEWS.

BRITAIN IN DEPRESSION.

Prepared by a Research Committee of the Economic Science and Statistics Section of the British Association. *Sir Isaac Pitman & Sons, Ltd.*, London, 1935. pp. 473. 10*s.* 6*d.*

The quest for reliable sources of information is, and always has been, the most time-consuming of the activities of the historian. Research on Ancient History is hampered by the relative poverty of sources of any description, so that it is frequently impossible to establish the occurrence of quite important events by the triangulation of corroborative statement. To-day the problem has changed: the amount of material of possible value is so great that in sifting what he can of it, a man is in danger of never reaching some of the most important information. In an age when reviews and bibliographies of the literature on almost any scientific subject are readily available it is clear that a logical step would be the preparation of some sort of bibliography of contemporary history, in which would be mentioned the sources which could be consulted with most profit.

The British Association was aware of the value of such an undertaking twenty years ago, and a review of industrial and financial conditions during the War was issued in several volumes. After the close of the War no further publications were made.

With the arrival of the general depression it was realised that it was necessary that a source book of material relating to this crisis in economic history should be compiled while the relevant matter was at hand, and that this period should be connected with that covered by the previous publications by means of a series of brief reviews of post-war industrial development. A Research Committee appointed by the Council of the British Association carried out the work, and the results are presented in "BRITAIN IN DEPRESSION."

Containing rather less than 500 pages, the book is divided into two unequal parts. Part I includes an Introduction, giving in outline the economic and political history of the period between 1919 and 1935, which is followed by chapters on Currency and Banking and Industrial Relations. Part II is divided into 21 chapters dealing in a non-controversial manner with the following industries: Agriculture, Coal, Fuel, Rail and Road Transport, Shipping, Shipbuilding, Iron and Steel, Engineering, Non-Ferrous Metals, Building, Cotton, Wool Textiles, Hosiery, Oil-milling, Glass, Pottery, and Consumers' Trades,

The book closes with a chapter on National and Social Finance. All the Chapters are followed by bibliographies, with the exception of the Introduction, and the chapters on Industrial Relations, Hosiery, and Rail Transport, though the last has sources indicated in foot notes.

Considering that the book is the work of a team, it is surprisingly uniform in treatment throughout. The chapters are all to the point, very brief, and provide an interpretation of the history of each industry in a form most acceptable to the layman. A number of industries reach the notice of the man-in-the-street only when, on account of some crisis peculiar to them, they become " front-page news " in the daily press. In this book, he is able to understand how a particular crisis developed and what its effects were.

The chapters and their sub-divisions cover an immense amount of ground, and leave little room for criticism on the score of omission. In view of the fact that a place has been found for such industries as Milk, and Livestock and Meat, it is a little surprising that no mention is made of the Fishing Industry, which in the last few years has appeared to be in a critical position. In addition it might have been illuminating to devote a page or two to discussing the production of Rope, Cord, and String during the depression and the period just preceding it.

It is a tribute to the completeness of the book that so little can be said concerning omissions. Moreover, the necessity of discussing general tendencies and of sketching broad outlines regarding each industry has not prevented the inclusion of a wealth of interesting facts. These, together with the brief chapters, make the book very readable, and well worthy of a place on the shelf as a book of reference. In its prime function as a bibliography of sources of information for serious workers on the economic history of this period it is to be commended very highly, and it is to be hoped that the series formed of the War-time volumes and the present book will be augmented in the future with works of a comparable aim and standard.

R. G. F.

* * *

SOVIET SCIENCE.

By J. G. Crowther. *Kegan Paul, Trench Trubner & Co. Ltd.*, London, 1936, pp. 342, 2*s.* 6*d.*

Of the internal activities of the U.S.S.R. which have been brought to the notice of the average man elsewhere perhaps none has created such a deep impression as the " Five-Year Plan " system, especially as regards its influence on Scientific and Industrial development. For years now it has been generally realized that scientific research is being carried out in the Union on a scale quite without parallel, and of it a fair proportion is concerned with problems as yet of purely academic interest. How this scientific work is linked to the nexus of economic and industrial arrangements becomes clear after a perusal of Mr. Crowther's book. In the Preface the author states that " the aim of this book is mainly to give information about the sort and conditions of research in Soviet scientific institutes ", and he deserves congratulation for having rigidly adhered to it throughout, as well as for having handled his material as objectively as could be expected.

Discussion of possibly controversial points arising from the general economic policy of the U.S.S.R. is omitted, and little comment is made on the efficiency with which the vast schemes of organisation are carried out in practice. The book is divided into five parts. The first deals briefly and very readably with Soviet outlook and organization, and concludes with a farrago of information about the Academy of Sciences and the Scientists' House in Leningrad. The second to fifth parts are devoted respectively to Physics, Chemistry, Applied Science, and Biology, and, with one exception, each chapter deals with one or two Institutes.

About a third of the book is devoted to information concerning five Institutes designed for research in Physics. Descriptions throughout appear to follow a formula in which a brief note on the buildings of the Institute is followed by mention of the better known members of the personnel and brief accounts of their work and that of the Institute as a whole. This treatment is by no means as mechanical as it might appear at first sight: the summarized accounts of the work are easily understandable and extremely interesting.

Chemistry is represented by an account of three Institutes which extends over 35 pages, and Applied Science by sundry details of eight Institutes devoted to such widely different subjects as optics, aerodynamics, electrical engineering, mineralogy, fertilizers and ceramics.

Part five, covering Biology, deals all too briefly with the experimental work being carried out in this direction. A chapter of outstanding interest is that on the work of the Lenin Academy of Agricultural Science, under the Presidency of Professor N. I. Vavilov. The author has thoughtfully indicated in the text where further details of the programme of this Institute may be obtained. The account of the Medical and Biological Institutes contains information no less fascinating, but the absence of any reference to Applied Zoology (apart from medical work) is definitely to be regretted. Veterinary problems and the zoological aspects of Animal and Plant Pathology are of great importance, and mention of the Soviet organisation for dealing with them would have been very welcome.

In the last part a few notes are presented to indicate the attention which is being devoted by the Academy of Sciences to the history of its own subject ,and the book is concluded with an index in which the few errors would seem relatively safe from detection.

R. G. F.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Invert Syrup Production direct from Cane. *F. A. Lopez Ferrer.*

So far, 16 Cuban factories have been making this product, and in 1935 they produced 54,468,283 (U.S.) gallons. With continuance of restriction upon sugar output, the amount of syrup that can be marketed at a good price is about 60,000,000 gallons.

Operations are the same as for the production of crystal sugar up to the meladura. But no more lime is used than is required to produce a *pH* of 5.8 or 6.0, which corresponds to an inversion of 3 or 4 per cent. when the juice is warmed up to more than 100°C. in the heaters and evaporators.

Then the syrup at 54 or 60° Brix is subjected to inversion with sulphuric acid in the proportion of 0.85 to 1.0 gallon per 1,000 gallons of juice, which means 1.75 to 2.0 gallons per 1,000 gallons of final invert syrup.

Mixture of acid and syrup is effected in tanks with steam coils and compressed air, and must be done gradually and thoroughly to avoid caramelization. This " active inversion " lasts 50 to 60 minutes, and results in a syrup of 30 to 45 purity.

In the next operation, called " inversion in repose ", the mixture is maintained at rest at a temperature corresponding to the the working temperature in a vacuum pan. It is then concentrated under vacuum to 85 or 87°Brix. Before being discharged from the pan, the syrup is treated with one gallon of milk-of-lime (at 12 to 15 Bé.) per hl. of pan capacity, so that the *pH* on discharging is about 6.8.

The ideal invert syrup should contain 25 to 30 per cent. real sucrose, and from 48 to 53 per cent. of invert sugar, approximately 78 per cent. of total sugars. The total sugar content might be raised to 80 per cent., but this would require more acid, a lower temperature, and a longer time. The three factors of acid, time and temperature must be adjusted so as to secure maximum factory economy. Metal surfaces should be treated with acid-resistant paint to diminish corrosion.—(*Inter. Sugar Journal*, Vol XXXVIII, No. 448, pp. 141. 142, 1936.)

* * *

***Oliver Filter Performance.** *By S. A. Wickey.*

To date 13 Hawaiian mills have installed Oliver filters for handling settlings from the clarifiers; with one exception these installations have taken the place of plate and frame filter presses. Questionnaires were sent to the mills where Oliver filters were in use; the present paper shows the averages of the data on capacities &c.

As regards increased sugar recovery, the installation of Oliver filters has been followed by a reduction of pol. in filter cake amounting to 74.3 per cent. The quantity of cake, due to bagasse screenings added as a filter aid, increased 56.4 per cent.; figured on total sugar in cane the sugar lost was reduced 60 per cent. A very small drop in purity between the clarified juice and the filtrate from the Olivers is the general rule; this tends to a higher sugar recovery than when working with plate and frame presses.

As regards decreased labour costs, one attendant per shift can easily run a filter station consisting of several Olivers, an additional operator may be required to load and shift mud cars, but either or both these jobs may be combined with other work. At one factory that formerly required 12 to 14 men at the filter station, one-third of the time of one man per shift is now required. In another case labour costs were reduced from seven to two cents per ton of sugar passing the filters. Since the quantity of cake to be spread on the fields is increased 56.4 per cent. an additional labour cost was noted at one factory; at others it is claimed that the greater ease of handling the muds has more than compensated for the added quantity.

As to lowering of filter medium costs it is reported from Koloa that this is half a cent per ton of sugar produced (using " 00 " perforated brass screens). At the same factory the previous filter cloth expense, not including labour for patching, was five cents per ton of sugar.

As regards reduced fuel consumption considerably less water is used in washing the cake on an Oliver filter; five mills report average per cent. water on cake of 154.5 per cent. or 6.9 per cent. on cane, which is much less than required with plate and frame filter presses.

The average rate of mud elimination is 0.585 ton per 100 sq. ft. of filter surface per hour, at a speed of about 14.3 revolutions per hour.

The quality of the work done at the Oliver filter station is affected by the efficiency of the settling department. When very thin settlings are encountered, the filters have to be operated at high speed, resulting in a thin cake through which fine suspended particles pass, necessitating recirculation. When this circumstance arises it may be met by changing to a finer mesh bagasse screen and increasing the fibre ration, if the sifter capacity is sufficient. The Oliver filter is capable of doing very good work on thin muds if operated at a low speed and if sufficient filter area is provided for handling the desired capacity.—(*Facts about Sugar*, Vol. XXXI, No. 6, p. 224, 1936.)

* In Reports *Assoc. Hawaiian Sugar Technologists, Chem. & Eng. Section* (1935), pp. 43-47.

FOR SALE.

Professor Shephard's *Report on the Economics of Peasant Agriculture in the Gold Coast* has been published by the Government of the Gold Coast and may be purchased at 4s. per copy from the Government Printing Department (Publications Branch), Accra, Gold Coast Colony or from the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. Summaries of portions of this report have appeared in *Tropical Agriculture* Vol. XII, No. 12; Vol. XIII, No. 3.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Borax as a Fertiliser.

It has long been known that a group of about ten elements plays an essential part in plant nutrition, but it is only during recent years that it has become recognised that other elements are of equal importance, though in such small amounts that their presence was previously unsuspected. Manganese and boron are the outstanding examples of these minor elements—' minor ' only in the sense that the requisite quantity is so small. Copper, zinc and other substances may also play an essential part in specific cases, and active research is in progress. The case with regard to boron is of definite economic importance. The pioneer work of Agulhon (1910) and Warington (1923) established the fact that in the entire absence of boron certain species, at least, are unable to develop properly. The necessary amount of boron is so small that most soils contain sufficient for the normal development of plants. During the last few years attention has been focused on certain obscure plant diseases for which no adequate explanation was forthcoming, and in many cases amelioration has been obtained by the application of boron compounds to the soil. Heart rot of sugar beet and brown heart of turnips are notable examples of this, and it is becoming a recognised practice to include a small quantity of boron compounds with the fertiliser, 12 to 20 lb. of borax per acre representing the safe limit, beyond which there is danger of injuring the plants by poisoning them. The great economic importance of this point has led to the establishment of a Boron Agricultural Bureau under the aegis of Borax Consolidated, Ltd., for the purpose of collecting and distributing information with regard to the use of borax for agricultural purposes. A word of warning may not be out of place. The beneficial results so far obtained by the application of borax as a specific against certain plant diseases may lead to undue optimism, and to a tendency to attribute every obscure plant disease to lack of boron, without adequate inquiry. The necessity for continued research must be emphasised, as it seems possible that the correct use of various ' minor ' elements may lead to definite and valuable progress in agricultural practice.—(*Nature*, Vol. CXXXVII, No. 3474, 1936, p. 900.)

* * *

Flooring Material from Bark.

Tree bark is now being used as " Permex ", a new flooring material composed of ground bark with inert mineral fillers. The material is said to resist abrasion, not to absorb oils or stain readily, not to become sticky or rough, and not to scar. The first application was made to factory floors, but it is even recommended for specialities such as desk, table, and counter tops, and for electrical panelling.—(*Ind. Bull.*, Arthur D. Little Inc. No. 106, 1035. Abstr. in *J. Chem. Education*, Vol. XIII, p. 95, 1936.)

Tung Oil Consumption Increases 70 Per Cent. in Four Years.

Industrial consumption of tung oil in the United States has increased approximately 70 per cent. during the past four years, bringing the total for 1935 to approximately 127,600,000 pounds, according to the Commerce Department's Chemical Division. This compares with an estimated consumption of 121,500,000 pounds in 1934, 105,000,000 in 1933, and 75,000,000 during 1932.

Based on the average domestic price of 18 cents per pound during the year, American manufacturers paid in the neighbourhood of $23,000,000 for tung oil in 1935. With the exception of relatively small quantities from Gulf Coast plantations, where an American tung industry is now being developed, all of our 1935 supply of tung oil came from China, the original home of the tung tree. The paint and varnish industry utilizes more than 75 per cent. of the tung oil consumed in the United States. The linoleum industry is the second largest user of this product (*Industrial and Engineering Chemistry, News Edition*, Vol. XIV, No. 9, 1936, p. 184.)

* * *

Nitrogen Fixation in Egypt.

Power generated at the Assuan Dam will be employed in the manufacture of " nitrochalk ", a fertilizer containing 15.5 per cent. nitrogen. The proposed fertilizer plant is expected to require a capital of approximately $35,000,000, and a minimum annual output of 300,000 tons of fertilizer material is contemplated.

An Egyptian Government committee proposed that the enterprise be operated by an Egyptian limited company with a foreign participation of 49 per cent. The foreign group participating will be charged with construction and plant operation for 20 years, at the end of which time the plant will revert to the government. Imperial Chemical Industries, Ltd., London and the English Electric Co. are negotiating jointly for the contract.—(*Industrial and Engineering Chemistry, News Edition*, Vol. XIV, No. 9, 1936, p. 178.)

* * *

Rapid Drying of Heavy Leather.

Wet leather is coated with a thin layer of a kieselguhr-water paste. The moisture in the leather is drawn by the strong capillary pull of the kieselguhr coating into the wet paste, evaporating at the outer surface of the coating, which is later removed. It is possible to dry leather at temperatures as high as 180°F without discolouration or injury. Sole leather bends are dried in this way at 156°F in 5½ hours in a commercial dryer, giving a 97 per cent. reduction in drying time as compared with the older methods.—(*Chem. & Met. Eng.*, Vol. XLII, p. 539, 1935. Abstr. in *J. Chem. Education*, Vol. XIII, p. 45, 1936.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observation is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR. — Prices on the Home Markets have ranged as follows (c.i.f. per cwt.) :—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
28th May	4	8½	8	5¼
4th June	4	9¼	8	6
11th June	4	9	8	5¼
18th June	4	7½	8	4¼
25th June	4	6¾	8	3¾
2nd July	4	3¾	8	0¾
9th July	4	5¼	8	2¼
(11th *July*, 1935)	4	3¾	8	0¾

Unsettlement in the foreign exchange situation has affected the market adversely. Refiners are adequately stocked for the time being and sellers are showing resistance to lower prices.

* * *

RUBBER.—Quotations for plantation sheet have ranged as follows :—

	Pence per lb.
27th May	7 5-16
3rd June	7 5-16
10th June	7 5-16
17th June	7 5-16
24th June	7½
1st July	7½
8th July	7¾
(10*th July*, 1935)	5 15-16

Prospects in the rubber market show signs of improvement but there has, as yet, been little change in prices. On 24th June, stocks of rubber in the United Kingdom had shown declines for 16 consecutive weeks. Motor manufacturers are busier, and the removal of "sanctions" is considered to have eased the political tension in Europe. The danger to the gold currencies has been diminished by the declaration of the new French Government. The export duty on native rubber in the Dutch East Indies has been raised from 34 to 35 cents per kilo. Stocks in the United Kingdom on 24th June amounted to 124,261 tons compared with 170,954 tons on 22nd June, 1935. Home trade deliveries for the first five months of the year are below those of the corresponding periods of 1935 and 1934 indicating that they have been living largely on stocks. A sudden jump in May deliveries suggests an increased demand for immediate consumption.

* * *

GRAPEFRUIT.—Small quantities of West Indian grapefruit were still available on 15th June, Jamaicas realising 15*s.* to 18*s.* per case and Trinidad 15*s.* to 22*s.*

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association :—

	American Mid.	*Egyptian F.G.F. Sakel*
29th May	6.64	8.67
5th June	6.68	8.69
12th June	6.82	8.84
19th June	7.00	9.03
26th June	7.11	—
3rd July	7.18	—
10th July	7.58	—
(12*th July*, 1935)	6.94	7.99

Business in American cotton has been moderate. West Indian Sea Island remains quiet but firm.

* * *

COCOA.—The upward movement in the Accra market referred to in our last report has continued, being aided by the firmness which the important shippers have maintained. Prompt shipment, of this grade, of last crop is quoted at 28*s.* 6*d.* c.i.f. and new crop 28*s.* 9*d.* Locally the market is bare of stocks and prices are firm with an upward tendency. $11.75 per fanega for Plantation Cocoa is freely paid.—(*By courtesy of the Cocoa Planters, Association of Trinidad, Ltd.*)

* * *

LIME PRODUCTS.—*Lime Oil.*—Handpressed is valued at 35*s.* per lb. *ex* wharf. There are sellers of Distilled at 22*s.* 6*d.* per lb. *ex* wharf, but the demand is disappointing.

Lime Juice.—There is no demand for Concentrated. Raw is slow of sale, but the value is unchanged at 2*s.* to 2*s.* 6*d.* according to quality.—(*West India Committee Circular*, 4th June, 1936.)

* * *

BANANAS.—Jamaicas have advanced in price to £19 5*s.* delivered London and £19 nearest station provinces, and remain in good demand. Brazilians are unchanged at £15 nearest station.

* * *

COFFEE.—The London spot market has been quiet while prices in New York have been steady. The quality of most of the coffee offered was of an end of the season variety. One good parcel of Blue Mountain Jamaica realised 199*s.*

* * *

MANGOES.—Small quantities of mangoes were received from Jamaica, but their condition was very variable, some being useless. Sound fruit sold well. Prices ranged from 2*s.* to 9*s.* per dozen according to condition.